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Engineering News-Record

Traffic Distributing Centers for the Triborough Bridge, New York

Local Flood Protection Rationally Revised

Dust Control Devices Aid Fight Against Silicosis

Heating Water Tank Risers by Electricity

Rapid Progress Made on Construction of Norris Dam

Some Midwinter Construction Notes

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STAFF REPORT OF

THE ANNUAL MEETING OF THE
AMERICAN CONCRETE INSTITUTE

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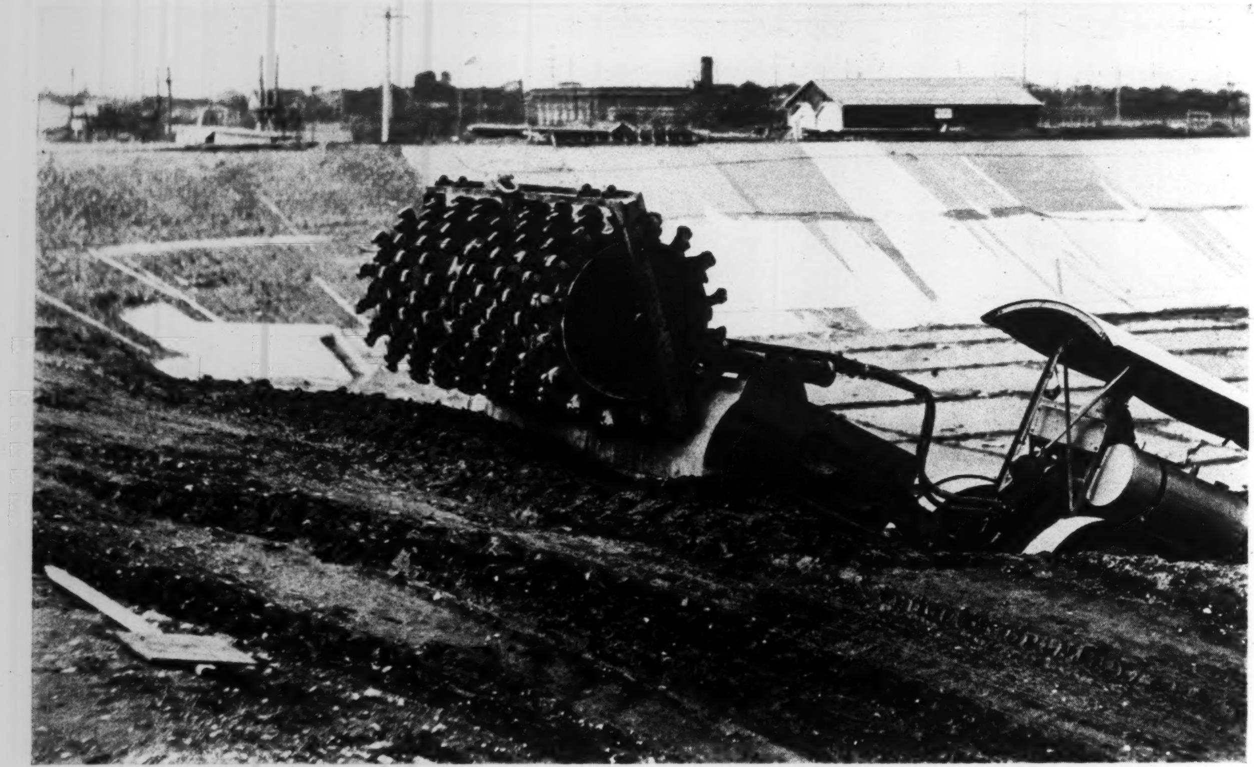

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In the News:

FIVE BIDS were received by the Port of New York Authority on the under-river section of its proposed Midtown Tunnel under the Hudson, when bids were opened on Feb. 21. Three bids were all within a few thousand dollars of each other. The low bid, nearly a million dollars below these three, was submitted by Mason & Hanger, a firm that has done a notable amount of similar tunnel work both at New York and Boston in recent years.

HIGHWAY OFFICIALS from ten North Atlantic states in convention urge federal grant of $400,000,000 for U. S. roads and regular federal aid of $125,000,000 a year for two years.

DIVERSION of gasoline taxes to hospitals is advocated by Dr. John J. Moorhead, professor of traumatic surgery, Columbia University, New York, who says: "Since accidents result from travel by automobile on the roads of the country, part of the road and gas taxes should go to the community hospitals to compensate them for these cases."

NO MORE APPLICATIONS from private corporations, except railroads, will be considered by PWA. Future housing loans will be made only to governmental housing authorities from the $100,000,000 fund of the PW Emergency Housing Corp.

THE GRAND COULEE DAM project has so far given work to 900 men—120 engineers, 500 men on general work and 380 on diamond-drill and excavation operations.

FATAL tenement-house fires in New York have prompted a new crusade against fire-trap dwellings. Tenement House Commissioner Langdon W. Post estimates that 75 per cent of the multiple dwellings in Manhattan are of "old law" type, in effect condemned a quarter century ago as unsafe. One of the objects of the crusade is prompt utilization of some seldom-used powers that the city holds for forcing abandonment of these old buildings.

BIDS on the Post Office Annex at New York have been opened at the office of the Supervising Architect in Washington. This is the fourth set to be called within a year.

BETTER financial conditions in Massachusetts are reflected in the request of the state public works commission to have 78 combined loans and grants from the PWA changed over to grants only. The commission finds that it can finance the remainder itself. The PWA's approval of the request releases $8,000,000, and this amount has been allocated to projects on the PWA waiting list.

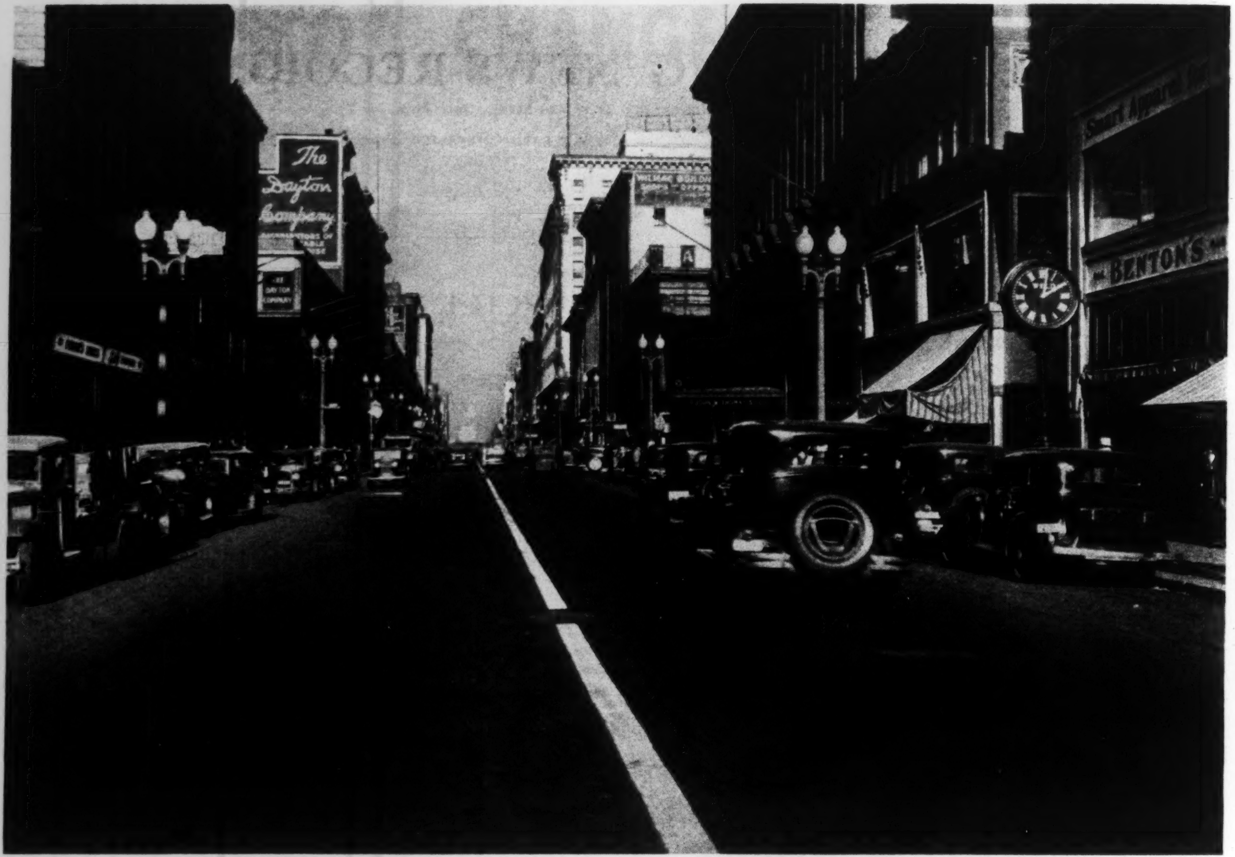
In This Issue:

WHEN the Triborough Bridge, built to provide new and more direct connection between Long Island and the upper end of Manhattan Island and Bronx Borough, New York, is completed, much of its usefulness will depend upon how expeditiously traffic from the densely populated districts to the north and west of the bridge is carried past existing traffic arteries at the eastern end of the bridge on Long Island. Conditions at the Long Island end are not ideal because of existing streets, elevated transit and railway lines. How these limitations are to be met is described in this issue. The layout provides for a large margin of traffic over the critical requirements.

COLLECTING large damages from contractors through imagined cases of silicosis, a lung disease caused by silica dust, bids fair to become another racket. The best way to fight such a racket is for the contractor to be one jump ahead of those who would collect from him by that means. Knowledge of the disease and its causes, also of means of minimizing dust hazards, is essential to such a fight. A summary of present information on these points is given in this issue.

RATIONAL METHODS of determining levee heights were applied to the reconstruction of the largest levee system in North Carolina—that protecting the Caledonia Prison Farm—when its reinforcement and partial reconstruction were undertaken in 1930. Subsequent floods have shown the advantages of the methods employed. Details of these methods are given in an article by Thorndike Saville and Charles E. Ray, Jr.

THE AMERICAN CONCRETE INSTITUTE held its 30th annual convention last week in Toronto, Canada, the home of some of the organization's most active members. Stimulated by the climate and local practice, winter concreting occupied a prominent place on the program. Promise of continued improvement in concrete technique and design was contained in papers on molded architectural concrete, high elastic-limit reinforcing steel, special cements and concrete-durability studies. New knowledge of plastic flow and stresses at cracks was presented. It was an active and worthwhile meeting. A full report is published in this issue.



Atlas White traffic marker on Nicollet Avenue, Minneapolis. Installation by City of Minneapolis. Fred Paul, City Engineer. J. C. Vincent, Traffic Engineer.

White—UNDER HEAVY TRAFFIC

As Fifth Avenue is to New York, as State Street is to Chicago, so is Nicollet Avenue to Minneapolis. Every day the traffic roars along that busy, bustling central thorofare—pleasure cars, business cars, busses, trucks. A traffic marker on that street meets heavy duty. No temporary marker can stand the gaff. White concrete markers do.

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New York

March 1, 1934

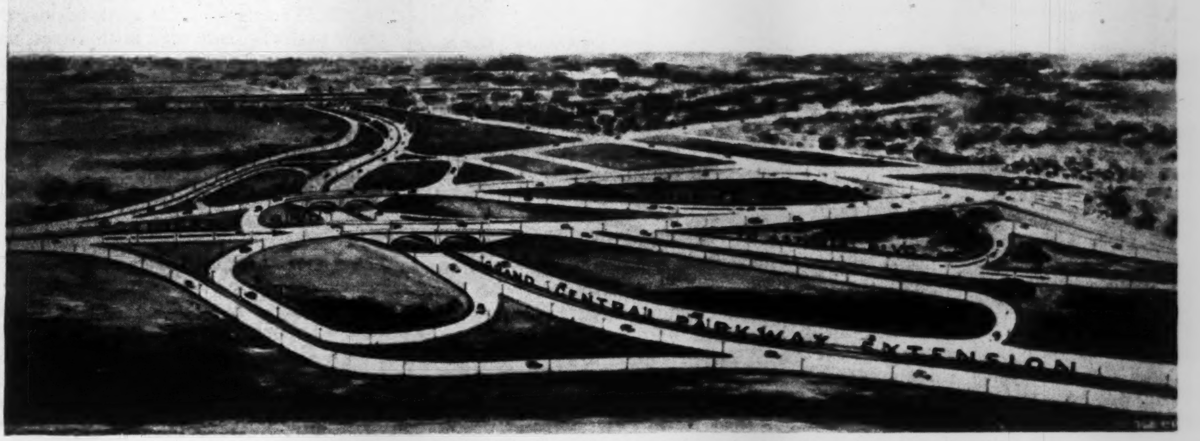

FIG. 1—FIVE LONG ISLAND ROADS intersecting the parkway from Triborough Bridge through Queens Borough call for elaborate layout for grade-separation and traffic interchange.

Traffic-Distributing Centers for Triborough Bridge, New York

Plans for sorting and distributing future heavy traffic to and from Long Island over the Triborough Bridge through populous Queens Borough include a depressed plaza and a complex interchange connection with the island parkways

By C. U. Powell
Engineer in Charge, Queens Topographical Bureau, Long Island City, N. Y.

RESUMPTION of work by means of a $44,200,000 PWA loan on the Triborough Bridge, New York, giving access from Manhattan and Bronx boroughs to the Borough of Queens and, through Queens, to the beaches and shore resorts of Long Island, has given impetus to providing means to pass the traffic through Queens. Itself a city of 1,200,000 people, Queens lies squarely athwart all routes to the resorts.

Queens approach route

From the bridge-head at 31st St. in Astoria to the junction with Grand Central Parkway just east of Kew Gardens (Fig. 2) is a distance of nearly 8 miles along the route that has been chosen. About 4½ miles lie west from the crossing of Northern Boulevard; the remaining 3½ miles connect Northern Boulevard with the Pretzel—as the elaborate junction of Grand Central Parkway, Interborough Parkway, Triborough Bridge Parkway and Union Turnpike has been called.

As far east as Northern Boulevard the bridge authority will construct this new outlet; over this portion also the authority will aid the city in acquiring the land for right-of-way. South of Northern Boulevard the state park commission stands ready to construct the parkway as soon as the city takes title to the necessary area for right-of-way.

Plaza distribution exits

The great plaza, or distribution station, in Astoria is planned to handle an immense traffic—sixteen parallel lanes, eight headed in each direction. This will care for the eight lanes on the regular level of the bridge, and the eight additional lanes to be carried on the upper deck, when increasing traffic makes it necessary to build that deck.

Traffic from the bridge will be passenger cars and business vehicles. The latter must leave the route before reaching the parkway proper, which starts about a mile east of 31st St. As shown by the plan of the plaza (Fig. 3), the first point of exit is at 29th St., where the bridge roadway first comes down to ground level. There is a second at 42d St., about 2,500 ft. east of 31st St. Over this distance the entire route is subsurface to Steinway St.; from this point the eastbound traffic mounts a ramp 450 ft. long, with a 3.5 per cent grade, to reach the surface. Exit to Astoria Blvd. is provided 700 ft. east of 49th St. Another, but for cars headed west and not going to the bridge, is 300 ft. east of 31st St. A 36-ft. lane, available under the 35th St. crossing, goes up a 3 per cent ramp, which discharges the cars on the north side of the plaza, between 32d and 33d streets.

Two future exits from the plaza appear just west and east respectively of

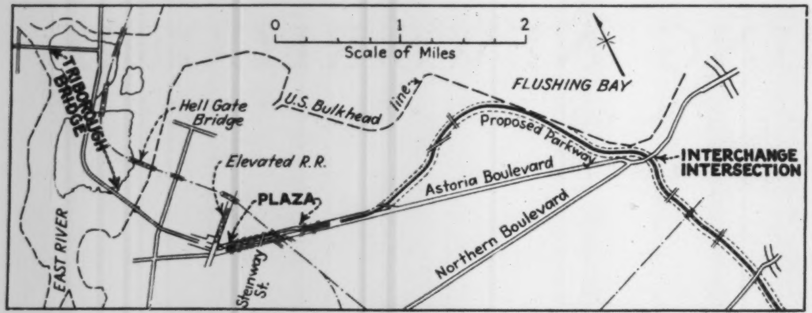
0
1
2
Scale of Miles
FLUSHING BAY
TRIBOROUGH BRIDGE
Hell Gate Bridge
U.S. Bulkhead line
Proposed Parkway
Elevated R.R.
INTERCHANGE INTERSECTION
Astoria Boulevard
PLAZA
Northern Boulevard
EAST RIVER
Steinway St.

FIG. 2—TRIBOROUGH BRIDGE PARKWAY route through Queens, showing locations of terminal switching plaza and interchange intersection at Northern Boulevard.

the crossing of the New York Connecting Railroad. That to the east is for Connecting Highway, a proposed express road paralleling the railroad as far as Queens Boulevard—a little over 2 miles. This will merge into Queens Boulevard and will pass traffic into Jamaica and other parts of the southern half of the borough. West of the railroad crossing over the plaza is the exit for the so-called bypass running down across Brooklyn and designed to connect eventually with the proposed Narrows Tunnel at Fort Hamilton.

To care for the upper-deck bridge traffic of the future, the ramp from 35th St. will be extended upward toward the west and, passing above 31st St. but below the elevated railroad traversing that street, will reach the top floor of the bridge. In crossing 31st St. it will occupy the space now devoted to the subway mezzanine station, which will be rebuilt at a new location just south of the new ramps to the bridge upper level.

Clearances for this treatment are barely adequate. It has been the practice in all this work to consider 14 ft. as the standard under all bridges, measured at the center of the roadway. First studies here indicated that, to maintain this standard, it would be necessary to raise the level of the existing elevated structure by 2 ft. Now, however, it has been decided that a clearance of 12 ft. will be sufficient for the upper-deck approach, as all trucks will be routed over the lower deck. That will leave the subway roadbed undisturbed and require merely the relocation of the station.

Plaza switching yard

The plaza, as planned, becomes, in effect, a switching point for traffic headed for the sector swinging between east and south, and a gathering station for both that designed to cross Triborough Bridge and that which, coming in along the parkway from the east, goes to local destinations in Long Island City.

Exits for cars from the bridge are fourfold: (1) local, leaving at any one of the three openings where business traffic must depart; (2) south to Brooklyn and beyond along the bypass; (3) southeast along Connecting Highway to Queens Boulevard and onward; (4) east by two routes (a) along the new parkway and then running down to meet Grand Central Parkway at Kew Gardens; and (b), mandatory for trucks, along the greatly widened roadbed of Astoria Boulevard.

Grades throughout have been held to a maximum of not more than 4 per cent. The main slope up to the suspension bridge span is about 3.7 per cent. From beneath 31st St. to the 29th St. bridge entrance is some 3.2 per cent (11 ft. in about 345 ft.). From 33d St. to the mezzanine floor for the upper deck of the bridge is only about 2.3 per cent, for the 33d St. crossing is at an elevation some 6 ft. higher than the roadway of 31st St. Finally, the ramp between 33d St. and 35th St., as mentioned earlier, is only 3 per cent.

Parkway interchange intersection

Part of the extension eastward of the main parkway route from the new Triborough Bridge over the East River in New York involves an elaborate crossing of Northern Boulevard, Figs. 1 and 4. Five roads from the west, besides the new parkway, converge in this area, and all must be carried across the parkway express roads without grade-crossings or red lights. This is accomplished by use of two twin-span bridges about 300 ft. apart. A third single-span bridge under Northern Boulevard carries Astoria Boulevard traffic south without stoppage for lights.

Northern Boulevard is the main east-west artery through Queens Borough to the north shore resorts of Long Island (Route 25-A). It now takes nearly all the eastbound traffic from Queensborough Bridge and is 100 ft. wide from southwestern Long Island City to the Nassau County line (11¾ miles), except that it still lacks physical completion, including widening, in two places, one of which is the area here under consideration.

As will be noted from the plan and from the reproduction of a perspective drawing (Fig. 1) looking toward the south, Northern Boulevard's 100 ft. becomes split into two one-way roads. These are each 40 ft. wide before joining Astoria Boulevard and Hayes Ave. respectively; from those junctions they are 60 ft. wide, until diversion of traffic to the parkway permits narrowing them to 50 ft. At this width they carry along for some distance within the 150-ft. total width of Northern Boulevard, being separated by a mall tapering slowly from 20 ft. to a point.

Meantime the Triborough Bridge Parkway (or Grand Central Parkway Extension—it goes by both names) comes sweeping in from the northwest to the crossing. It consists in this area of two 32-ft. one-way roads separated by a 20-ft. mall. Each road provides for three lanes of express traffic, limited

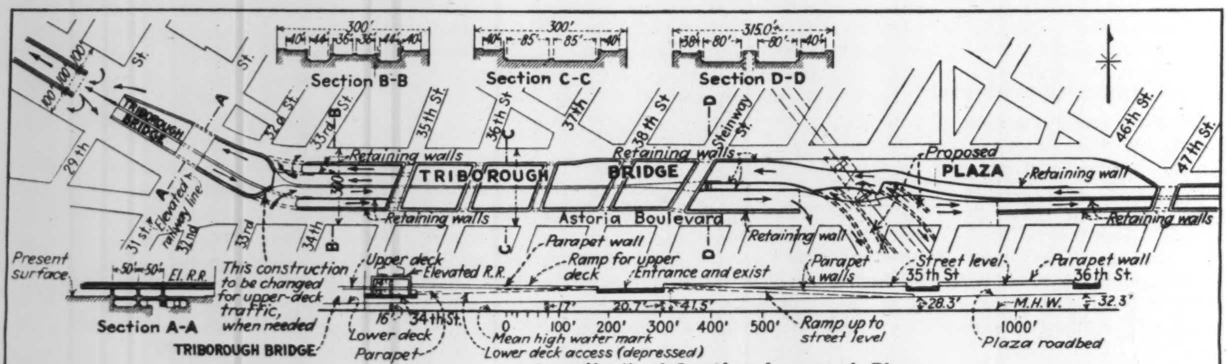
300'
40' 44' 36' 36' 44' 40'
Section B-B
300'
40' 85' 85' 40'
Section C-C
315.0'±
38' 80' 80' 40'
Section D-D
St.
St.
100'
100'
100'
TRIBOROUGH BRIDGE
A
29 th
32d St.
33rd B St.
35th St.
36th St
C
37th
38 th St
D
Steinway St.
46th St.
47th St.
Retaining walls
TRIBOROUGH
BRIDGE
Retaining walls
Proposed
PLAZA
Retaining wall
300'
Retaining walls
Astoria Boulevard
Retaining wall
Retaining walls
A
Elevated railway line
31 st.
32nd
33rd
34th
B
C
Parapet wall
D
Present surface
50' 50'
El. R.R.
Section A-A
TRIBOROUGH BRIDGE
This construction to be changed for upper-deck traffic, when needed
Upper deck
Elevated R.R.
Ramp for upper deck
Entrance and exist
Parapet walls
Street level
35th St
Parapet wall
36th St.
16'
34th St.
17'
20.7'
41.5'
28.3'
M.H.W.
32.3'
Lower deck
Parapet
0
100'
200'
300'
400'
500'
1000'
Mean high water mark
Lower deck access (depressed)
Ramp up to street level
Plaza roadbed
Longitudinal Section Approach Plaza

FIG. 3—PLAN, profile and sections of distributing plaza in cut at Queens terminal of Triborough Bridge.

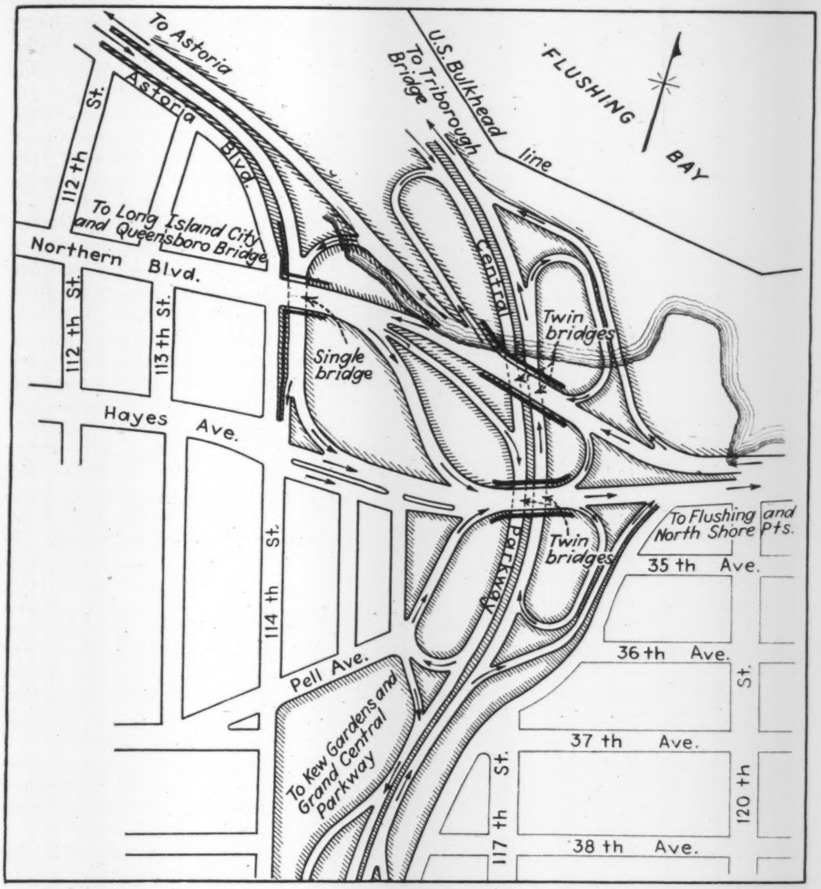

FIG. 4—GRADE-SEPARATION and interchange ramps at crossing of Triborough Bridge Parkway and Northern Boulevard in Queens. Extensive filling will be required in Flushing Bay.

to pleasure cars. Passing under the two 60-ft. sections of Northern Boulevard, this parkway will carry a heavy traffic from Triborough Bridge, 4½ miles away to westward, to Grand Central Parkway at the Pretzel, 3½ miles south.

That two bridges suffice to carry the five roads across the parkway is due to the fact that they merge, in some instances well before the parkway is reached. All eastbound traffic thus uses one bridge. Westbound, all of the traffic for these streets crosses the parkway by the northernmost of the two twin-span bridges before separating. About 270 ft. beyond the bridge it splits. Cars for Astoria Boulevard take the right-hand road; those for Northern Boulevard and New York take the left-hand. Cars going to Hayes or Pell Ave. take the Astoria route and then swing left, 300 ft. farther on, into the road passing southward beneath Northern Boulevard. From this they reach Hayes Ave. directly, or Pell Ave. by continuing a block farther southward along Peartree Ave. (114th St.).

Structural features

A considerable part of this layout runs into the present waters of Flushing Bay. Much fill will be required, for the lowest road level in the adopted plan is 8 ft. above mean high water. This insures safety against overflow from a combination of an unusually high spring tide and a long-continued northeast storm which sometimes floods the present roadway of Northern Boulevard in a section 1,500 ft. east of this crossing, where the present elevation is only about 5 ft.

Bridge clearances in all cases are at least 14 ft. in the center of the span and 11 ft. over the sidewalk areas at the ends of the span. The two bridges over the parkway have the upper and lower roads separated by 18 and 19 ft. respectively; that under Northern Boulevard is 19 ft. also.

Grades are held as low as topographical conditions permit. Along the parkway they are negligible. On access drives between the parkway and the boulevard they do not exceed 4 per cent, and in most instances they are well below that. On the main traffic arteries they are held mostly below 2 per cent; but some of the side roads show, in a few cases, grades approaching 5 per cent.

Agencies directing work

While the widening of Northern Boulevard is purely a New York City matter, the parkway is being built, along with the Triborough Bridge, by a special bridge authority. South of Northern Boulevard the parkway will be built by the (state-controlled) Long Island State Park Commission on lands furnished by the city of New York through condemnation proceedings.

All of the routes were laid out by engineers of the Queens Topographical Bureau, under the writer's direction and that of Albert E. Thomas, principal assistant engineer. The elaborate crossing here described was designed jointly by this office and the park commission engineers. The bridges are from the designs of the state department of public works.

◆

Bonnet Carré Spillway Operation Outlined by War Department

THE MANNER in which the War Department expects to operate the Bonnet Carré spillway is outlined in a formal statement by the Secretary of War made on Dec. 22 for the information of the highway and railway engineers charged with the design of bridges across the spillway channel. The spillway is from the Mississippi River above New Orleans and discharges through a channel across the neck of land between the river and Lake Pontchartrain. The type and character of bridges to carry the railway lines into New Orleans across the spillway channel has been the subject of much discussion between the representatives of the railroad and of the War Department.

In his statement the Secretary of War said, in part: "It is the intention of the War Department that the flow of water from the Mississippi River through the Bonnet Carré spillway shall be controlled so as to preclude any substantial amount of drift passing through the spillway, and that the floodway shall be kept in such state of maintenance that there will be no injurious collection or injurious passage of drift in the floodway through highways at railroad crossings.

"It is likewise the intention of the War Department that the flow of water in the floodway shall be so regulated that there will be no detrimental scour or fill at any place, and that there shall be such regulation of flow as to prevent injuries to highways and railway structures crossing the floodway which fulfill as to design the requirements of the War Department as outlined in permits granted and agreements entered into."

Rapid Progress Made on Construction at Norris Dam

Preliminary construction operations at the dam site are carried forward by Tennessee Valley Authority by force account while the design of the dam is being developed

WELL-DEVELOPED construction plans and closely coordinated policies have resulted in good progress in building the Norris Dam project of the Tennessee Valley Authority. Field work already is more than a month and a half ahead of schedule. Indications are that the pace thus far set can easily be maintained without any undue pressure.

When the Tennessee Valley Authority was created early last summer, one of the few specific jobs assigned to it by the Congress was the building of Norris Dam, then called Cove Creek Dam on the Clinch River. The TVA had no engineering nor construction staff. In fact, the entire executive, engineering and construction staff had to be selected and organized during a time when many serious policy matters were being considered. At the same time some doubt had been raised about the character of the formation of dolomitic limestone at the site of Norris Dam. These foundation uncertainties had to be eliminated by further exploration by means of shafts and tunnels.

Additional studies of the Clinch River, on which the dam is being built, and of the reservoir area of more than 50,000 acres also were necessary before construction could be started. Based on the results of these studies, the original design of the dam and power house has been greatly changed from the designs that were originally submitted to Congress before the formation of the TVA.

Enough information was available by the middle of September, 1933, to make it safe to assume that the dam could be placed at the site originally selected. Once this was determined, the solution of several controlling construction problems could be undertaken. But so many of these problems would take time to solve that the job could not be let to contract without waiting several months; hence the decision to construct the dam by force account and thus proceed immediately.

Once the soundness of the rock formation at the site had been determined, one of the main problems was to decide the source of the fine and coarse aggregates for the 1,000,000 cu.yd. of concrete required in building the dam, the power house and various auxiliary features of the project. The site is in a rolling foothill country about 5 miles from a main-line railroad and some 30 miles northwest of the city of Knoxville. No similar volume of concrete has been placed in the vicinity. In the past, local practice has been to use sand and gravel from the Tennessee River for all classes of concrete structures.

Excellent coarse aggregates for concrete can easily be produced by crushing the limestone at the site with standard equipment. To obtain from the Tennessee River the volume of sand necessary for the project would have resulted in a surplus of gravel beyond any local needs, hence the cost of the sand from this source would have been high. It also would have been necessary to ship sand from the river about 25 miles over main-line railroads that carry heavy traffic. Furthermore, the rail connection to the site, estimated originally to cost $750,000, would have been required to handle the tonnage needed. Production of sand from dolomitic limestone next to the site was therefore studied.

Tests of numerous specimens of concrete made from the local limestone sand and coarse aggregates proved that they had greater strength than similar mixes of the river sand and gravel, or of the river sand and the limestone coarse aggregates.

FIG. 1—SITE OF NORRIS DAM on the Clinch River, looking north. The large cofferdam for the first operations in the river is shown in the center. At the upper left corner and on the shoulder of land at the upper right center are the excavations for the traveling towers of the cableway. The construction highway bridge is in the foreground.

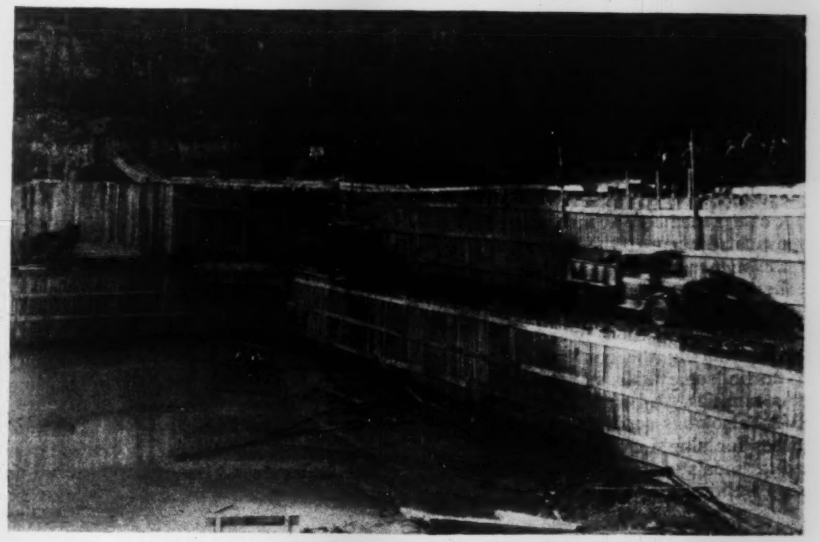

FIG. 2—INTERIOR of the river cofferdam. The cofferdam is of normal filled-crib construction. It is sheeted on both faces to avoid loss of fill in case of overtopping.

The next problem was to determine how to reduce the limestone so as to produce at the lowest cost the best-shaped aggregates, with the most satisfactorily graded sand, free from too many fines. Several manufacturers of crushing and grinding machinery have worked in close cooperation with the TVA organization in the solution of this problem. Hammer mills, rod mills and cone crushers are all being tested. Final decision as to type of equipment will depend on results of these tests. The details of the plant that will be installed to produce the 650,000 cu.yd. of crushed rock and the 350,000 cu.yd. of fine aggregates required will be described in a subsequent article.

Production near the site of the fine and coarse concrete aggregates reduced greatly the tonnage that had to be moved to the dam site from the railroad. This tonnage reduction, coupled with the advance in recent years in the design of automotive equipment and in highway engineering, permitted the decision to eliminate the $750,000 rail connection included in the original estimate for the project prepared some years ago. The heavy-duty highway that provides transportation facilities has been described recently (*ENR*, Feb. 22, 1934, p. 254).

Cofferdam operations

Clinch River at the dam site has had a maximum flow of record of 60,000 sec.ft. once in seventeen years. Probably the largest flow during any flood of modern times was about 70,000 sec.-ft. An unusually high stage would produce 50,000 sec.-ft. All cofferdam operations have accordingly been based on bypassing the latter volume of water. In case higher stages occur, the cofferdam has been designed so that it may be topped without loss beyond the cost of pumping out the water and silt. Equipment and machinery used in the excavation and in pouring the concrete will all be of such types that they may be quickly removed or will clear all stages of water in the stream.

The easterly end of the dam will be built first. A timber cofferdam inclosing the site of that part of the dam has been built up so as to carry the river stage of 50,000 sec.-ft. safely. This cofferdam, of the usual cellular timber-crib type filled with impervious material and closely sheeted on all exposed faces, extends out to mid-channel. Enough material was removed from the opposite bank of the stream to insure ample cross-sections to carry the high flow.

Comparatively litle earth and loose rock will have to be removed to expose the solid limestone formation on which the main dam will stand. As soon as the foundation is prepared, concrete placing will start and the concrete will be carried to a height of 40 ft. from the outer end of the cofferdam to the east abutment. During pouring of the second section, the low flow of the river will be handled through temporary openings in the dam, while floodflows will be allowed to overtop low blocks.

Mixing and placing plant

An excellent site for a quarry from which to obtain the concrete aggregates was located directly upstream and about 1,500 ft. in from the westerly end of the dam. The plant for producing and storing the fine and coarse aggregates for concrete will be placed between this quarry and the right-hand (west) abutment; the concrete-mixing plant will be erected slightly upstream from the abutment. This layout also was made desirable by the fact that the bulk of the concrete required in the dam and powerhouse will be closer to the right-hand end on account of the topography of the site.

Various factors reduced either to cableways or derricks the type of equipment that could be considered for transporting concrete from the mixing plant to place in the dam. For several reasons, cableways were considered preferable and were adopted.

In the first place, the crest length of the dam is about 1,700 ft. To move concrete from the mixing plant at one end across to the other for derrick-placing would have required a double-track trestle, and a trestle was considered hazardous in a stream of this type. Another handicap with the derricks would have been a limited capacity for handling other operations and concrete-placing and formwork. Lack of flexibility with the derricks at fixed points was likewise considered unsatisfactory.

Cableways avoided all these objections. They also leave the space below them unobstructed. At the same time, all equipment used in connection with them may quickly be shifted to above high water in an emergency.

Two 1,900-ft. cableways of 18-ton capacity on traveling steel towers are being erected. Both have a travel of 400 ft. The two head towers are adjacent to the concrete-mixing plant. Motor-driven transfer cars, operating on tracks extending from the mixing plant to within range of the cableways, will deliver concrete in 3-yd. tilting buckets. Three 3-yd. mixers are being installed. Each transfer car will mount two of the titlting 3-yd. buckets from which 6-yd. bottom-dump buckets handled by the cableway will be charged.

This arrangement of tilting buckets on the transfer cars permits the cableway buckets to be charged much quicker than they could be unhooked and hooked on. It also eliminates this very dangerous operation and enables the operator to speed up cableway service considerably.

Time schedules for the mixer plant and cableway operations contemplate easily making a round-trip with a cableway bucket in from 2 to 3 min., depending on the point at which concrete is being poured, the height of the concrete already in place and various other factors. When running normally, all three mixers are to be operated. Under these conditions it is expected to be possible to place 120 to 180 yd. of concrete per hour.

Working conditions

Four shifts of men are employed on all operations on the dam. Each shift works 5½ hours. The 2-hr. interval during each 24 hour is arranged to come in the middle of the day. This plan permits equipment maintenance and minor repairs to be handled under the best daylight conditions.

When these notes were prepared, 800 men were engaged on the dam and power-house features of the project. Counting the forces working on various other features of the undertaking, the TVA had at that time on this entire job

1,400 men in the field on its payroll. In addition, 25 CCC camps are located on the watershed, with about 5,000 men employed in soil-erosion correction and various operations incidental to the main undertaking.

Men on the TVA payroll on the project are drawn from all the southern states included in the TVA area, the bulk of the members from the rural communities adjacent to the dam site. Many of the men residing in the vicinity live at home and travel back and forth in their own cars. The TVA is, however, erecting a model town near by that will be used during the construction period to house some 250 married men and their families. Adjacent to the site, the TVA also has completed five bunkhouses for single employees, a mess hall and a men's recreation house. These camp buildings combine excellent housing facilities with economy of construction and a permanency of construction uncommon in most construction camps built at similar expense.

Type of employee

So much romancing has been printed about the "hill-billy" type of Tennessee Valley inhabitants that it is noteworthy to record the fact that experience on this project shows most of these reports to be fiction. The TVA did exercise great care in selecting men of the right type—having physical fitness, natural aptitude for the work to be performed and sufficient experience.

Results to date with the forces thus recruited from these southern states, and mainly from the farms and the hills near the job, are premature as a basis of final conclusion, but close observation of the men at work on the job shows an unusual personal interest in what is being done. As Ross White, superintendent in charge of construction on Norris Dam, expresses it, "Any man on the job can handle a gang." He also is convinced that men on this job are equal to the best he has worked anywhere in 25 years' experience in heavy construction in various parts of the United States and Canada. He finds that they have great initiative, resourcefulness and energy.

A. E. Morgan, chairman of the Tennessee Valley Authority board, personally has charge of all construction operations of the authority. C. H. Locher is construction consultant on all TVA undertakings. Barton M. Jones is engineer in charge of construction on Norris Dam. Mr. White is construction superintendent on the project, and F. G. Schlemmer is Mr. White's assistant.

Dust-Control Devices Aid Fight Against Silicosis

Test results and latest developments of dust-control apparatus as used on Rockefeller Center excavation work in New York City—Large savings in drilling costs indicated—Pathology of silicosis

THE DEVELOPMENT of equipment to combat silicosis, that strange but serious hazard confronting the construction industry, is of vital interest to all engaged in rock removal. This is an apparatus developed by George S. Kelley, associated with Geo. J. Atwell, Inc., foundation contractors, of New York. Control of dust at its source, the drill hole, is the most important step in fighting the disease. Two large foundation jobs in New York City have been proving grounds for a dust-collecting apparatus that represents one of the important pioneer efforts to accomplish such control after many past attempts had ended in failure.

Trials were made in the Metropolitan Life Insurance Co. building foundation and the excavation for the Rockefeller Center project. On the Metropolitan Life job the apparatus was, as considered now, crude and cumbersome, but efficient (*ENR*, May 26, 1932, p. 752). On the Rockefeller Center work, a year later, the dust-separation device had been improved, the large sheet-iron affair used on the previous job being replaced by a compact portable unit mounted on a small truck (*ENR*, May 26, 1932, p. 754). The equipment has been further improved in the past year.

The situation on the Rockfeller Center work was ideal for obtaining performance and cost data on rock-drilling with and without dust collectors. On two adjacent contracts in identical rock conditions, the Atwell company equipped one job with dust collectors after having completed all rock-drilling on the other by the usual method of using dry hammer drills. Not only was the health hazard practically eliminated on the second of these two contracts, but large savings in drilling costs resulted.

On both the Metropolitan Life and Rockefeller Center projects the dust-collecting equipment was confined to down-drilling with hand-held pneumatic hammer drills. At Rockefeller Center in May, 1932, a demonstration was made of developments of dust-removal hoods suitable for drifters and stopers. Following this demonstration, careful tests were made of the efficiency of the drifter and stoper units. Results of these and other tests, just made available for publication, are presented later.

Characteristics of silicosis

Silicosis as a menace to construction has become a subject of grave importance almost overnight. Contractors and others interested in rock-drilling have had little opportunity to learn much about the disease. Most treatises on the subject are written from a medical standpoint, couched in technical terms confusing to the layman. Following is a brief description of the characteristics of silicosis, taken largely from a booklet on the subject published by the Metropolitan Life Insurance Co., of New York City.

The term "pneumonoconiosis," meaning dust in the lungs, has been employed to designate disease of the lungs resulting from dust inhalation of any sort, although preference is now given to the use of more definite terms descriptive of the type of dust. Among those more frequently used are silicosis, asbestosis, anthracosis and siderosis, signifying lung conditions produced by silica, asbestos, coal and iron particles, respectively. Silicosis is by far the most important of these diseases because it distinctly predisposes to tuberculosis. Workers engaged in a variety of undertakings have designated silicosis by a variety of terms, such as miners' phthisis or miners' consumption, potters' asthma, stonemasons' phthisis and grinders' rot. The cause is identical in all, the inhalation of silica dust.

Silica, or silicon dioxide, may be the main constituent of a dust arising in a variety of industrial processes, such as mining, quarying, manufacture of abrasives, rock-drilling and excavation, sandblasting, blasting of buildings, foundry work, etc. The higher the percentage of free silica in dusts, the more hazardous they become. Silicates—dusts low in free silica but containing large percentages of combined silica, usually in the form of calcium or magnesium silicate—exhibit their effect in a milder form, and, so far as is known, with much less tendency toward the development of tuberculosis.

Dust particles must be in a very fine state of subdivision to penetrate the lung tissue—that is, to reach the air cells. It has been commonly accepted, following experimental work at the South African Institute for Medical Research, that only particles less than 10 microns in greatest diameter can traverse the finer air passages to reach the air cells. A micron is 0.001 mm., or 1/25,000 of an inch.

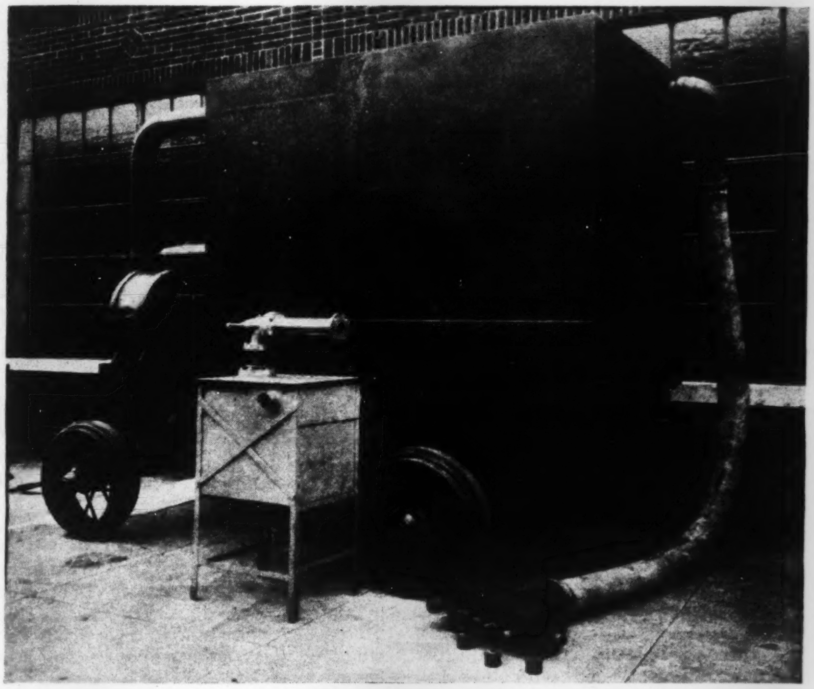

FIG. 1—COMPARATIVE SIZES of fan-driven 1,000-c.f.m. type of dust collector and jet-driven 100-c.f.m. type. Fan-driven units were used on Rockefeller Center job. The small jet-driven unit is the latest type of portable collector.

The time necessary for the development of a case of silicosis depends upon several factors, all of which in part determine the actual amount of silica which reaches the lungs. These factors are: the amount of free silica in the dust; the amount of dust in the air of the working place of sufficient fineness to penetrate the lungs; and the extent of exposure or duration of time which the individual spends working in the dust. Evidently the larger the value of these factors, the more rapidly silicosis will occur, but even where the amount of silica in the dust is very high and the individual works daily in a very dusty atmosphere, the development of silicosis is usually a matter of years. Often the time element ranges as high as five to twenty years, though sometimes two or three years suffices to produce a serious condition.

Some instances have been reported wherein silicosis has occurred in a year or less, but this is not the usual experience and it is possible that there are other factors involved which are not, as yet, fully understood. While individual susceptibility might be considered as influencing the development or progress of silicosis, there is little evidence to show that such is the case.

The characteristic effect of silica dust on the lungs is to produce fibrous tissue which is of the nature of scar tissue. The exact mechanism of production of fibrosis in the lungs caused by the inhalation of injurious amounts of minute particles of silica and its extraordinary relationship to tuberculosis are still matters of research. The early theory of the mechanical action of silica has been abandoned. There followed a theory of chemical action, with the suggestion that silica acted as a tissue poison. More recently the theory has been put forth that the action of silica is physico-chemical due to the formation of silica-hydrosol, and that different silicious dusts may vary in their harmful effects in proportion to other substances present which may tend either to stimulate or retard the formation of silica-hydrosol.

None of these theories, however, explains why the silicotic lung tends to become tuberculous. It is well known that tuberculosis frequently complicates silicosis and may intervene at any stage of development. Research is being conducted in the United States both by the Public Health Service and the Saranac Laboratory, with the hope of achieving definite knowledge upon which must depend, largely, further progress in the prevention and treatment of silicosis.

Inasmuch as silicosis develops over a long period of time, the onset is gradual and insidious. The outstanding characteristic of the disease is a gradually increasing shortness of breath, with little or no evidence on ordinary physical examination to account for it. As the disease progresses, the shortness of breath becomes more and more pronounced until ordinary work is no longer possible. In the early stages of silicosis the individual looks well, tends to put on a little weight and is free from fever. A dry cough develops sooner or later, and there is usually a tendency to catch cold easily. Even in well-advanced cases, little can be found on physical examination of the chest, though symptoms become more and more aggravated. The diagnosis must depend upon the correlation of the patient's occupation, his symptoms and an X-ray of his lungs, the latter being most important. Without X-ray findings a positive diagnosis of silicosis is difficult, if not impossible.

Cost data at Rockefeller Center

The rock-excavation work at the site of Rockefeller Center, between 49th and

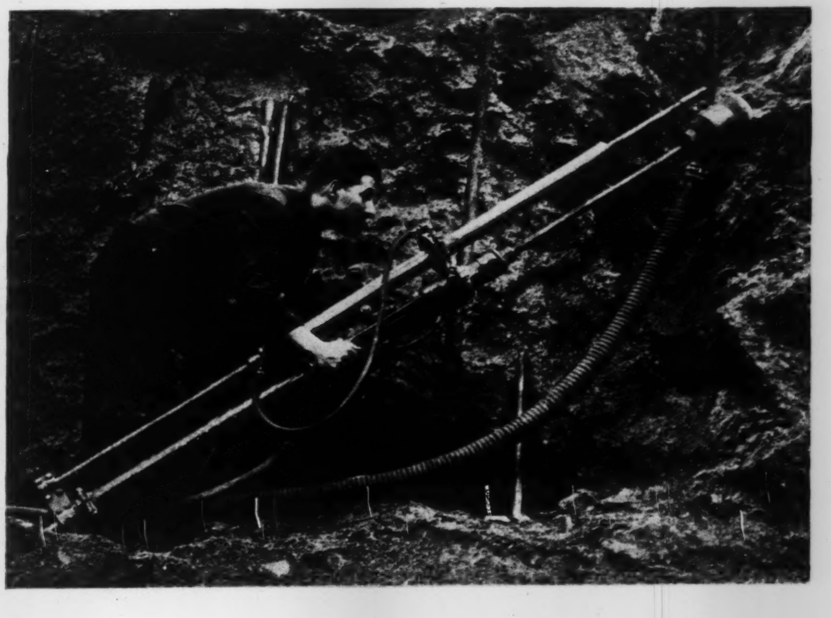

FIG. 2—STOPER DRILL equipped with exhaust hood for dust control. Hood is carried by auxiliary pneumatic column attached to stoper shell.

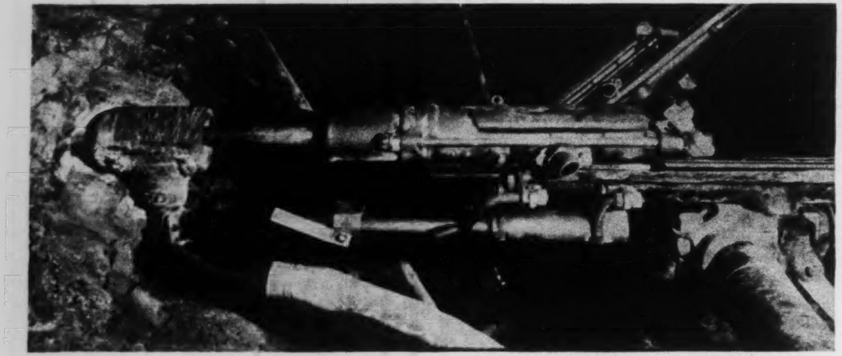

FIG. 3—DRIFTER DRILL equipped with molded rubber dust hood carried by auxiliary arm mounted on drill shell. Hood carrier is adjustable to meet all drilling conditions.

50th Sts., Fifth to Sixth Aves., New York, was divided into two separate contracts, both contracts being held by the Atwell company. Contract No. 1 included the site of buildings 1 and 9 on the east side of Sixth Ave., covering an area of 535 ft. by 200 ft., excavation depth averaging 40 ft. Contract No. 2 was for the site of buildings 2 and 3, covering the rest of this block, with an average depth of excavation of 38 ft. The yardage involved in contract No. 2 was somewhat smaller than that of contract No. 1.

The rock-drilling and removal operations were identical on both the contracts, except that on contract No. 2 the drills were all equipped with dust collectors.

TABLE I—SAVINGS IN DRILLING COSTS AT ROCKEFELLER CENTER WITH USE OF DUST COLLECTORS

	Contract No. 1 No Dust Control Cost, Per Cent	Contract No. 2 With Dust Control Saving, Per Cent Per Foot
Item No. 1—Cost of Line Drilling		
A. Labor........	100	25.00
B. Insurance.....	100	22.60
C. Drill Steel.....	100	15.10
D. Equipment....	100	25.90
E. Material......	100	00.00
F. Overhead.....	100	25.00
Item No. 2—Drill-Steel Sharpening		
A. Labor........	100	48.20
B. Insurance.....	100	44.60
C. Trucks..........	100	55.60
D. Equipment....	100	00.00
E. Material......	100	48.30
F. Overhead.....	100	48.30
Item No. 3—Compressed Air		
A. Labor........	100	23.30
B. Insurance.....	100	17.20
C. Trucks........	100	41.20
D. Equipment....	100	—112.80
E. Electric service	100	83.50
F. Material......	100	—135.10
G. Overhead.....	100	22.70
Item No. 4—General Expense........	100	33.40
Total feet drilled....	158,000	92,952

Notes: Item 1A—Labor costs of operating dust equipment on Contract 2 are included.

Item 1D—On Contract 2, 43 per cent less drills were used to drill 41 per cent less rock, as compared with Contract 1, resulting in saving of $0.0076 per hole-ft.

Item 2A—Saving in sharpening labor costs on Contract 2 is attributed to holes being kept free of dust and cuttings, eliminating grinding action of the bit, maintaining the gage better. Fewer broken bits per unit of hole footage on Contract 2.

Item 2C—Saving due to longer use of steel, requiring less nipping. Same is true of Item 2E.

Item 3D—Equipment costs higher because of rental of dust-collecting equipment.

Items 3E and F.—Much of equipment on Contract 2 was gas-engine-driven, accounting for saving in electric service cost; oil, gas, etc., included in Item F, accounting for increase in this item.

The rock in this total area ran very uniform and was composed of typical Manhattan schist of medium-hard character. The holes were drilled 14 ft. in depth, using a 2¼-in. bit on the starter and a 1½-in. bit on the 14-ft. steel. The steel was a 1-in. hollow hexagon utilizing a four-wing bit with 14½-deg. straight taper. Sharpening, tempering and heat-treating of steel were uniform throughout the job.

The savings in drilling cost on contract No. 2, on which dust control was used, over contract No. 1, are given in Table I in percentages of saving per foot of drilling. The cost data include the cost of rental and operation of the dust-collection equipment.

The savings in drilling cost are attributed to increased drilling speed and better efficiency of the drill operators. The dust trap served to keep the holes clean at all times, enabling the drill bit to bite on fresh rock, eliminating the drill power formerly lost in grinding up part of the cuttings left in the hole under the ordinary method of drilling. The morale of the drill runners was raised when they realized that the dust-collecting installation was primarily for the benefit of their health, resulting in faster and better work. Then, too, it was found that under the normal system of drilling the drill runners were prone to run with a partly closed throttle to keep the dust cloud, always causing discomfort, at a minimum. With the dust trap in use, the cloud of dust was, of course, eliminated, and the operators could run the drills with full throttles.

Efficiency tests

The following study of the efficiency of the Kelley dust trap and collector, as used in rock-drilling and excavation work at Rockefeller Center, was made by the Industrial Health Service of the Metropolitan Life Insurance Co. The study includes a determination of dust counts of the air in the vicinity of the work during the operation of the drills with and without use of the dust-control apparatus. The samples were taken at the breathing level of the men operating the drills. Three types of drills were used: the jackhammer blower type No S-68; the N-75 drifter type and the R-51 stoper.

The number of dust particles per cubic foot of air at the breathing level of the operators under various conditions and with the use of various types of drill is given in Table II.

TABLE II—THREE-DAY EFFICIENCY TESTS ON VARIOUS TYPES OF DRILLS WITH AND WITHOUT USE OF DUST-CONTROL EQUIPMENT

Sample No.	Station	Air Sampled, Cu.Ft.	Total Dust Count, Particles, Under 10 Microns, Per Cu. Ft. Air	Remarks
First Day:				
3	General air sample..............	114.9	1,079,000	
1	Center of 6 S-68 jackhammer drills	15.45	7,368,000	Exhaust hoods in use, interference by blowing of condensed water in air lines.
2	Duplicate of sample 1............	10.04	11,752,000	Sampled simultaneously with Nos. 1 and 2.
4	Discharge end of dust collector...	18.45	4,552,000	
5	Same as sample 1................	10.20	90,196,000	Without exhaust hoods, normal drilling, interference by water in air lines.
6	Duplicate of sample 5............	9.92	114,858,000	
7	Alongside N-75 drifter...........	11.24	4,804,000	Exhaust hoods in use
8	Duplicate of sample 7............	10.22	5,283,000	
9	Discharge end of dust collector....	13.53	2,365,000	Sampled simultaneously with Nos 7 and 8.
Second Day:				
11	General air sample..............	140.00	543,000	
10	Discharge end of dust collector....	14.97	1,202,000	Sampled simultaneously with No. 12.
12	Center of 4 S-68 jackhammer drills	19.68	3,455,000	Exhaust hoods in use.
13	Same as No. 12................	12.30	331,707,000	Normal drilling, no exhaust hoods used.
14	Discharge end of dust collector....	9.82	15,071,000	Sampled simultaneously with No. 15.
15	Alongside N-75 drifter...........	12.82	15,288,000	Exhaust hood in use.
16	Alongside stoper drill............	7.34	23,978,000	Exhaust hoods in use.
17	Discharge end of dust collector....	7.34	6,558,000	Sampled simultaneously with No. 16. clutch on motor of dust collector was slipping.
Third Day:				
18	Alongside stoper drill............	10.20	317,647,000	Wet drilling.
19	General air sample..............	67.32	1,277,000	
21	Alongside stoper drill............	30.60	2,875,000	Exhaust hoods in use, dull drills used.
20	Discharge end of dust collector ...	30.30	1,518,000	Sampled simultaneously with No. 21.

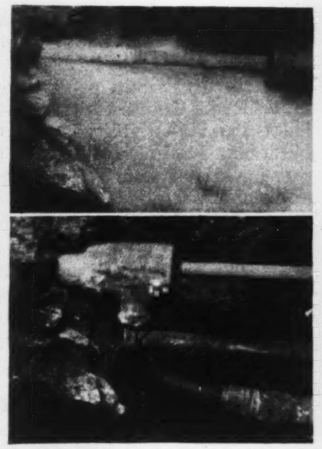

FIG. 4—DRILL operating with and without dust hood. Note stream of dust entering hood and absence of dust around drill with use of hood.

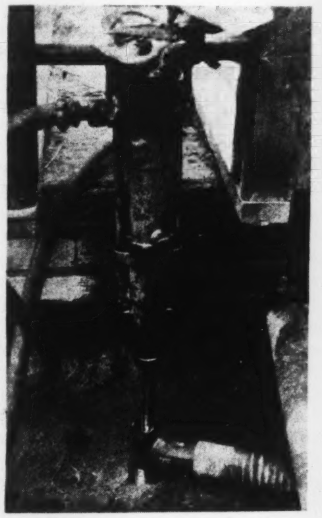

FIG. 5—JACKHAMMER DRILL and exhaust trap as used in speed tests. Drills were loaded uniformly with shot weights to provide uniform drilling pressure. The dust trap shown is the latest type designed for hand-drills.

On Nov. 27, 28 and 29, 1933, drill-cutting speed tests were run for the National Bureau of Casualty and Surety Underwriters at Rockefeller Center. No operators were used on these tests; a drill guide frame was constructed, and 25 lb. of steel shot was secured at the top of the drill, thereby eliminating the human element. No consideration was given to any of the factors that increase the overall efficiency of drilling except the actual cutting. Each drill's location was changed daily, and by the end of the test all drills had worked in the same areas.

TABLE III—COMPARATIVE DRILLING SPEEDS, N-75 DRIFTERS, PHILLIPSBURG MINE

Drill and Position	Drilling Speed: Actual, In. Per Min.	Drilling Speed: Over-all, Ft. Per Hour
South African Dustless		
45 deg. down......	16.3	35.5
Horizontal........	15.3	35.5
45 deg. up........	17.5	41.5
Average..........	16.4	37.5
American Wet		
45 deg. down......	16.3	32.3
Horizontal........	17.2	39.6
45 deg. up........	18.2	40.8
Average..........	17.2	37.0
Blower Type with Dust Exhaust Hood		
45 deg. down......	25.1	45.0
Horizontal........	24.0	46.2
45 deg. up........	22.8	44.4
Average..........	24.0	45.0

Three methods of drilling were used, with drills all of the same make and size: wet, dry and exhaust. The increased cutting speed of exhaust over dry drilling averaged 13.7 per cent. The wet drill on two tests was abandoned, as on Nov. 27 the temperature was 30 deg. F. and the drill froze continuously. On the 28th the location was a seamy schist, the hole lost the water and the three steels were stuck. On holes where the exhaust system was used the drills reached bottom without assistance, with the hole clean of all cuttings. The dry drills finished drilling in all cases with 6 to 18 in. of dust at the bottom of the hole. The dry drill, in most cases, had to be assisted to get the steel down.

Results of previous speed tests, made at a Philipsburg mine, are given in Table III.

Development of equipment

Ever since the dust-control equipment was first tried out on the Metropolitan Life job, it has been constantly improved. The basic principle of operation has, however, remained constant. The primary purpose of this apparatus is to remove rock dust at its source, the drill hole. Many types of equipment have been developed in the past, especially abroad, for this purpose, most of them proving unsatisfactory. Most of the earlier types sought to provide an air-tight seal at the drill hole and convey the dust away by air pressure. The Kelley system provides a negative pressure outside the drill hole, creating an air seal around the dust column to prevent dust escape at that point.

The dust-separating units remove the dust in three stages. The first two stages are separators that are designed to cause the settlement of the larger particles by gravity. To accomplish this, means are provided for reversing the direction of flow of the air stream and for reducing its velocity. About 96 per cent, by weight, of the total dust is captured in these two stages. The remaining 4 per cent, which consists entirely of the small harmful particles, passes on to a multiple-type filter. The effectiveness of this device, together with the further slowing down of the air to produce a very low velocity through the filters, serves to remove all but a very small proportion of the dust. The discharged air has a dust concentration well below the safe hygienic limit.

The dust-separating units in the larger sizes, up to 1,000 cu.ft. per minute capacity, are fan-operated and are mounted on trucks. Fans are located on the discharge end of the unit, so there is no dust traveling through the fan. Fans are operated by electric motors, gas engines or air motors, as field conditions require. A new type of portable unit, suitable for one or two drills, has been developed, using a high-pressure jet of air to create the required negative energy. This unit is mounted on legs and can be carried about the job. In all units the dust is collected in metal containers for easy disposal.

The Kelley-Atwell Development Corp., of New York, has been organized for commercial production of this dust-control equipment.

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Notes from the Road

—Winter Construction

Buffalo, N. Y.,
Feb. 15, 1934.

WINTER CONSTRUCTION in a week of 20 to 30 below zero, such as western New York has just experienced, faces real difficulties and needs a lot of enthusiasm to keep it going. Activity centers around CWA projects, of which every locality has its share. Street work predominates. Buffalo is getting miles of new streets complete except for curbs and asphalt surfacing — compliments of Harry L. Hopkins, of Washington. Also, thanks to the CWA, the city now has a 530-acre airport, which it wasn't expecting for some years longer.

A strike that indirectly resulted from the weather helped to complicate the problems of keping up progress in construction. CWA workers struck in protest against being docked for a lay-off. It seems that one day last week, when 14 below was high for the day, the CWA officials let the workers gather around bonfires instead of swinging picks, and the rank and file took it for granted that they were to be paid; but today's pay checks included no pay for this time spent in keeping warm, so the workers penalized themselves further by quitting.

PWA bond contracts lag

PWA projects still are largely stalled because of bond contracts not yet approved. Syracuse is waiting for PWA money for its Ley Creek sanitary sewer, a $1,650,000 job. Ickes is waiting for Syracuse to vote bonds. Contractors are waiting for bids to be advertised. Everyone seems to be waiting, including the families of potential construction workers.

One PWA job is actually under way in Buffalo. A local contractor, with a brand new pull-scoop shovel, is tearing through 3 ft. of frost and is laying precast concrete pipe sewers. The Great Lakes Concrete Pipe Co. is furnishing steam-cured pipe for this job. The contractor, an ex-plumber on his first construction contract, is going to find out next summer that Buffalo's street paving is only a few inches thick, but, excavating frozen subsoil, it now appears to him to be about 36 in. thick.

Elevating the New York Central through Syracuse

Back in 1899 Syracuse started to talk about getting the New York Central tracks off Washington St., one of the main thoroughfares. Last week work actually started on this huge grade-elimination project, involving 27 bridges and thousands of feet of retaining walls. The spectacle of the Twentieth Century train creeping down the middle of the street, dodging trucks and women drivers, will soon be only a memory. Walsh Construction Co. has really got a piledriver in action as the start of its $4,000,000 contract. Test piles are being driven at several bridge sites, though with the disconcerting result of having some of the longest test piles available still go down fast when the tops are below ground surface. Arch Duffie and Tom Lynch, of the New York Central, and Dave Small and Fred Smith, of Walsh Co., have renewed the old combination that successfully carried on the Central's difficult four-tracking program along the Hudson several years ago.

Harry Hayes, energetic secretary of the New York State Highway Chapter, A.G.C., is keeping an eagle eye on Capitol Hill in Albany these days, either protesting or approving every proposed legislative bill that concerns construction. Supporting the senators and assemblymen in favorable legislation builds up good will as an aid in fighting undesirable proposals, a tip that many organizations might find to their advantage.

Code enthusiasm dulled

Contractors are showing little interest in the construction code. The long delay in getting it through has dulled the enthusiasm of last fall. They are more interested in looking for work than in thinking about code provisions. And when a rare contract does fall in a surprised contractor's lap, he has a terrible time in getting a bond, regardless of how good a reputation he has. Buffalo contractors tell of going to Detroit, Cleveland, Chicago, St. Louis, New York and Boston, all in one bond-begging trip. And in Boston was noticed a Tacoma, Wash., contractor looking for a bond for a West Coast job. No wonder they are bewildered after experiences of 1929, when bond salesmen were thicker than cement peddlers at bid openings.

The New York Highway Users Conference is making a drive for a million signers for a petition to Governor Lehman demanding abolition of the emergency 1-c. gas tax and the restoration of funds obtained from the regular 2-c. tax to highway purposes only.

* * *

Saginaw, Mich.,
Feb. 22, 1934

Winter construction work any place north of the Mason-Dixie line this year is tough going, but the toughest I have seen is the substructure work on the two Grand Island bridges across the Niagara River below Buffalo. I saw this job being carried on in below-zero temperatures, with a searing, bone-cracking wind sweeping down the river.

Artificial islands used for pier construction

George Hockensmith, of Booth & Flinn, has developed an ingenious elevator for lowering concrete caissons from barges. But after landing the first of four on the South Bridge, he was forced to abandon this plan in favor of the island method of pier construction, because the heavy ice floes prevent manipulation of two large barges carrying an 800-ton caisson between them. Two barges and a tugboat have already been sent to the bottom by ice.

Detroit relies on CWA for all municipal construction

Construction conditions in Detroit this year are unique. The city's entire municipal construction program at present is CWA work. The bonding limit is already exceeded, because of reduction in assessed valuations, and thus there is no chance for the city to back up PWA loans with bonds. The same condition holds rather generally in Michigan.

Relief sewer construction, including several brick-lined tunnels and repairs to the city-owned street-railway tracks make up the bulk of the CWA projects, on which 38,000 men have been employed. The CWA program in Detroit and throughout this region has been upset by uncertainties in reduction of forces. Partly completed work has been abandoned in some cases.

Another contract has been let on the Woodward Ave. grade-separation program in Detroit. This will be handled by the state highway department as a project under the highway allocation of the Recovery Act. Dave Thurston Co. is doing the work.

Speedy action on Michigan roads provides work quickly

The Michigan highway department has been letting contracts at the rate of $500,000 per week since November. Weather permitting, dirt is usually flying by Thursday on contracts awarded the previous Friday. Bridge work is continuing despite cold weather, many contractors completely inclosing the units of structure within paper-covered housings. Road work in the sand-belt districts is carried on pretty well in cold weather, but grading Michigan clay roads is impossible with 36 in. of frost in the ground.

CWA road work

CWA forces are at work on the highways of the central and northern parts of Michigan. In Saginaw County a CWA crew is digging out a large drainage ditch preparatory to widening the road.

This particular job was started with hand labor, but now dynamite, a power shovel and half a dozen teams with scrapers have supplemented hand shovels. Yet the supervisor is still worrying about getting through before spring floods come, as the old ditch has been completely blocked off. Frozen chunks of clay are handled with teams and slings in the same manner as large boulders in rock work.

Removing street-railway tracks in Saginaw

The city of Saginaw has an interesting CWA project under way. A street-railway system folded up some time ago without removing the tracks from the streets; CWA workers are now tearing up the rails and the brick paving between and adjacent to the tracks and are replacing the brick with a concrete slab —poured daily regardless of weather conditions. Heated aggregates and water, plus a 3 per cent calcium chloride admixture, keep the fresh concrete from freezing until portable frames covered with waterproof paper can be placed over the slab and salamanders started within the inclosures. All concrete is mixed by hand, and amazing rates of progress are being made. After the bricks are cleaned they are trucked to another CWA project, the municipal garage, under construction. These old bricks, after 40 years in the streets, are used in both exterior and interior walls. The architectural treatment of the building is striking.

The Dow Chemical Co. is doing some remarkable work in gravel-road stabilization development. Test-road sections of various mixtures of sand, gravel, clay and silt, treated with calcium chloride, are built within a large warehouse. These test sections are pounded by loaded trucks for hours and days at a time. Test results of a new character are being obtained.

Highway engineers of the surrounding states have witnessed these tests. Your scribe got tangled up with a group of Indiana highwaymen in a poker game following an interesting day at the Dow plant. Editors have very little business associating with road engineers after dark.

H. W. R.

Local Flood Protection Rationally Revised

Old plantation levee on Roanoke River in North Carolina redesigned economically on basis of determined flood frequency and stream hydrographs

By Tnorndike Saville and Chas. E. Ray, Jr.

Professor of Hydraulic and Sanitary Engineering, New York University; and Former Chief Engineer, N. C. Department of Conservation and Development

THE NORTH CAROLINA department of conservation and development has recently been completing extensive reconstruction of and additions to the largest river levee system in North Carolina. The levees protect a large tract of land known as Caledonia Prison Farm, owned and operated by the state prison department of North Carolina. It is believed that the methods of repair and improvement are worthy of description, in view of the application of rational methods to a local flood-control problem and on account of various difficulties of the work. Locally the levees have always been called dikes, and hence this term is used throughout the article. These dikes, incidentally, have been built up at various periods during a hundred years' occupancy of the land.

In 1930 George Ross Pou, the superintendent of the state's prison, requested the department of conservation and development to make a complete survey of the dikes at Caledonia and to recommend detailed improvements. The survey was completed in October, 1930, and plans and specifications for the improvements were submitted to the superintendent, who subsequently authorized the conservation department to undertake engineering supervision of the construction and repairs which had been recommended.

Hydrology

The Roanoke River above Caledonia Farm has a drainage area of about 9,000 square miles. The stream is subject to frequent freshets and occasional large floods. Records of stage (U. S. Weather Bureau) have been taken since 1890 at Weldon, N. C., 23 miles above Caledonia. Records of discharge (U. S. Geological Survey) are available since 1912 at Old Gaston, N. C., 15 miles above Caledonia.

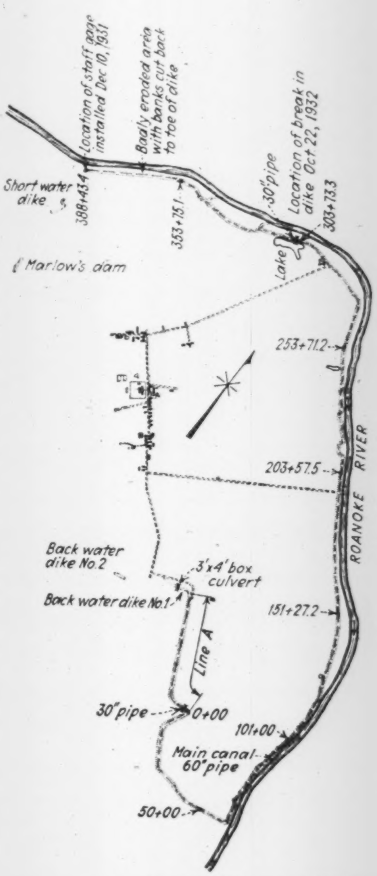

FIG. 1—FLOOD-PROTECTION LEVEE built up during a period of 100 years at Caledonia farm revamped on basis of modern rational determination of river hydrographs and flood frequencies.

On Fig. 2 are shown estimated hydrographs of several of the larger floods, based on readings at the Weldon and Old Gaston gages referred to the Caledonia gage. Simultaneous observations on the Weldon and Caledonia gages in 1931 and 1932 were utilized to produce Fig. 3, which is now used by the Caledonia management as a guide to precautions to be taken during floods. The heavy line in Fig. 3 is a generalization for local use derived from the results of observations indicated by the dotted lines, and shows estimated peak relationships. The effect of channel storage in the very flat channel of the Roanoke below Weldon is illustrated by these lines. As additional observations are made at the Weldon and Caledonia gages, Fig. 3 will doubtless be modified to indicate a more exact correlation. A typical hydrograph of the river at Caledonia in 1932 and 1933 is shown in Fig. 4.

Dike elevation and profile

The river dike was about 40,000 ft. (approximately 7½ miles) long; its top varied from 3 to 15 ft. above the normal farm-land level. The side slopes were variable but averaged about 1 on 2. The top width averaged 5 ft. The location of the dike is shown on Fig. 1.

At various times trouble has been occasioned by (*a*) overtopping of the dike by flood, (*b*) seepage through the dike, and (*c*) seepage beneath the dike, forming sand boils on the farm side.

A careful survey of the dike was made, controlled by a base line. An accurate line of levels and a transit traverse was run over the dike, and a contour map prepared. At each 1,000 ft. along the dike a cross-section was made.

It was not necessary to have the top of the dike level for the entire distance, as the river has an appreciable slope, which is probably at a maximum during the peak stages of floods. Considerable effort was expended in discovering records of flood heights at various points along the river throughout the length of the dike, and actual observations were made during two moderate floods in the early part of 1931. From these observations and from studies of gage height and discharge records, Fig. 7 was constructed. The essential accuracy of the flood profiles adopted was confirmed by observations during the flood of October, 1932, described later.

A study of flood frequencies indicated that the 1877 flood was of a magnitude which might be expected to be equalled or exceeded not more frequently than once in 100 years. To protect the dike against being overtopped or weakened by a flood of this magnitude would necessitate raising the dike for practically all of its length (see Fig. 7), involving a very large amount of earth work. The chief damage from a flood of this magnitude would be to fields and crops.

It was regarded as practicable within the limits of time and expense to plan to protect the farm from inundation by a flood slightly greater than that of 1912. At station 285+00, where the 1912 flood height was 96.18, an elevation for the top of the dike was established as 98. From this point a slope of 1.06 ft. per mile each way was adopted, and is indicated on Fig. 7. It will be observed that the original dike was higher than this from the north end of station 249+00 for a distance of 13,900 ft.

Dike renovation

From station 249+00 to the lower end of the dike the top was brought up to the grade established, requiring fills of 0 to 4 ft. at various places. The section was strengthened wherever necessary, and side slopes of 1 on 2 were obtained as a minimum. This cross-section is essentially that of the original dike

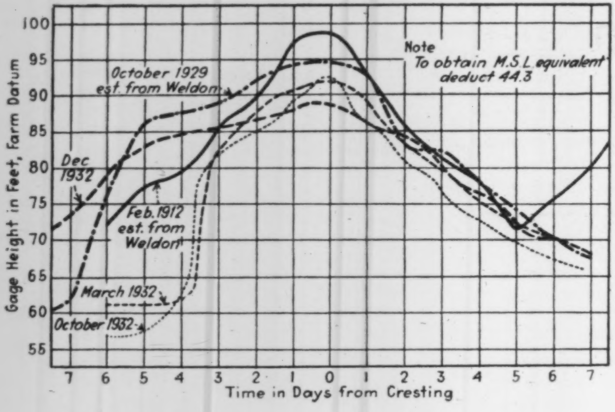

FIG. 2—HYDROGRAPHS of floods of record height on Roanoke River at Caledonia farm.

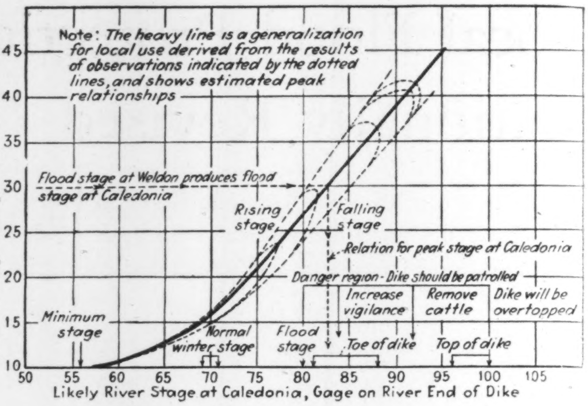

FIG. 3—RIVER-STAGE RELATIONSHIP at Caledonia and Weather Bureau gage at Weldon used in predicting flood stages.

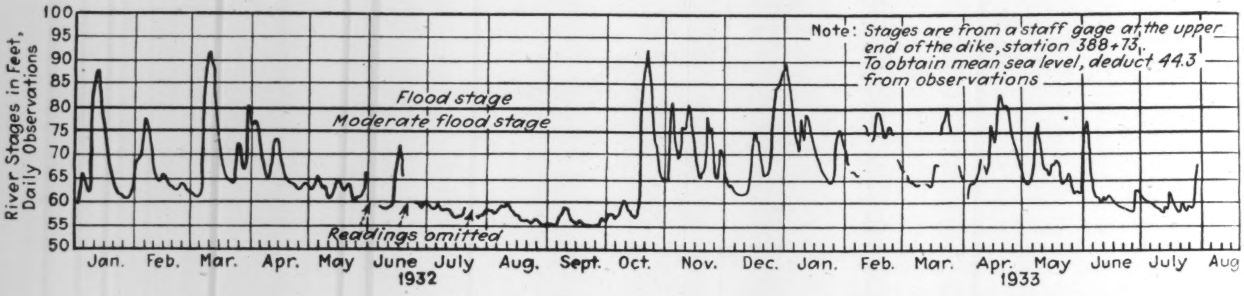

FIG. 4—HYDROGRAPH compiled from gage readings at Caledonia farm of river stages in 1932-33.

where it has proved safe for the past 70 years. Constructed with care, it is believed that this section should be adequate, particularly as the duration of floods is relatively short, as indicated by Fig. 2.

Careful inspection of the dike was made throughout its length, and samples were taken of the material composing it. Wherever inspection indicated that seepage had occurred or that the soil composing the dike was of a sandy nature, repairs were made by blanketing both sides with impervious material.

All trees and bushes were cleared from the dike and for a distance of at least 50 ft. riverward from its toe. In the section of the river bank between the dike and the river edge many trees were also removed to prevent them from being undermined by river cutting and hence becoming foci of erosion. The entire area of river bank between the river edge and a point 50 ft. from the toe of the dike was allowed to remain in willow growth where such growth had already become established, and the planting of willows or similar shrubbery is being encouraged to hold this section of the bank against erosion by the river.

Following the clearing and grubbing of the dike, the next procedure was carefully to backfill and tamp holes left by removal of the stumps. The dike section was then brought up to grade and to proper section by bringing in impervious material by means of dragpans. The material was carefully placed and tamped by the movement over it of the mules, dragpans and men. Subsequently efforts were made, and are being continued, to establish a firm sod of Bermuda grass or honeysuckle over the entire length of the dike.

From Oct. 15 to 17, 1932, a heavy

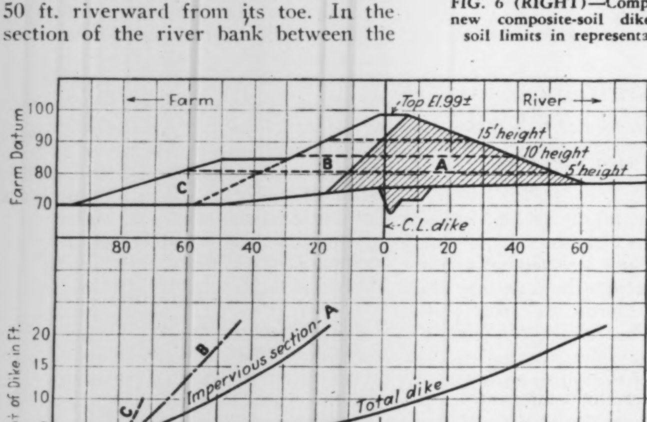

FIG. 5 (LEFT)—New dike section and yardage diagram.

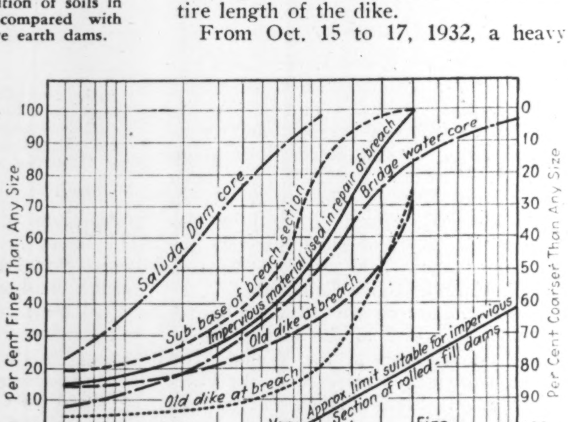

FIG. 6 (RIGHT)—Composition of soils in new composite-soil dike compared with soil limits in representative earth dams.

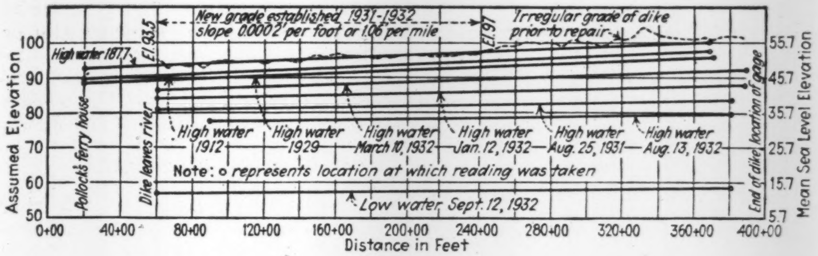

FIG. 7—SLOPES of record floods as related to original and replanned grade of dike.

rain storm covered the larger part of the Roanoke River drainage area. On the Caledonia Prison Farm property the rainfall was about 3 in., but in Virginia, involving the greater part of the watershed, the total rainfall exceeded 5 in. On Sunday, Oct. 16, the river at Caledonia Farm was at stage 57.0, which is low. By Tuesday a rise in the river had begun and the stage was 62.5. By Friday it had reached 90.2, and on Saturday morning, Oct. 22, it had reached its peak of 92.6. A number of previous floods had surpassed this flood without producing any failure of the dikes.

At about 4.15 p.m. on Oct. 22 a break in the dike occurred at approximately station 304+50 (Fig. 1) resulting in an opening 250 ft. long and requiring for replacement some 18,000 cu.yd. of earth. The breach in the dike resulted in the flooding of about 2,500 acres.

To close this break required the construction of an entirely new dike about 5,000 ft. long. This was constructed in a manner similar to that described for repairing the main river dike. Quantities involved as to yardage, and other pertinent data covering the construction and repair of the dikes described above are to be found in the accompanying table. It should be realized that all of the work was performed by convict labor, the only machinery of any nature used being dragpans, trucks and a tractor for moving dirt and stumps.

The repair was carried out in accordance with the section shown on Fig. 5. On Fig. 6 are indicated soil analyses of a number of samples of soil used in the repair of the breach. These have been superimposed upon analyses reported in two authoritative discussions of materials for rolled-fill embankments.[1] It will be observed that the material composing the original dike was unduly sandy and porous. The new dike section, as shown in Fig. 5, is composed of three parts: Part *A* on the river side has an outer slope of 1 on 2¼ and of 1 on 1 on the farm side, and has in its base a cut-off trench. Part *B*, superimposed on the land side of Part *A*, has a slope of 1 on 2 until it reaches into part *C*, which constitutes the berm on the farm side. The crown width of the berm is nowhere less than 20 ft., and is carried to an elevation of 85 ft. and has an outer slope of 1 on 2½. The berm is used as a roadway.

Part *A* is of maximum imperviousness, and the most impervious soil indicated on Fig. 6 was used. Part *B* is of more porous material, as its primary function is to assure stability and provide for drainage. Part *C* likewise is less impervious, and at the toe it grades into coarse sand and fine gravel to provide stability. All soil was placed in layers less than 8 in. deep and was thoroughly compacted by means of hand tampers.

GENERAL REPAIR AND IMPROVEMENT ESTIMATE FOR CALEDONIA DIKE SYSTEM
(Work was begun July 6, 1930, and continued intermittently to Aug. 1, 1933)

Item	Yardage	Linear Estimate, Ft.	Man-Hours	Team Hours	Truck Hours
1. Clearing and grubbing	......	38,800	173,817	......	....
2. Raising main dike to grade	11,852	24,000	14,477	7,398	....
3. New dike—line A	12,500	5,000	15,800	3,300	1,000
4. Spur dike at sta. 230+50	900	82	900	643	....
5. Repair of leaky sections	2,000	1,800	2,150	1,428	....
6. New dike—gut near Marlow's Dam	250	450	130	110	....
7. Repair of breach at sta. 304+75	23,000	250	58,636	280	2,380
8. Planting Bermuda grass from sta. 0+00 to 140+00	......	14,000	2,890	......	....
9. Repair of wave cut	2,100	14,000	6,292	......	....
Total	52,602	......	275,092	13,159	3,380

Dike maintenance

The improvements and repairs described will unquestionably result in a greatly strengthened embankment. It is realized that the dike is not high enough to protect against floods of magnitude equal to or greater than that of 1877, and that the materials and slopes even in the strengthened dike are not of a nature to give the maximum degree of protection. As has been stated, the cost involved in providing a higher degree of protection was not believed to be warranted. In consequence, a number of precautions have been set up to reduce to a minimum the danger of future difficulties with the dike.

1. Storage along the dike of 20,000 cement sacks for sand-bag purposes, and a quantity of 2-in. sheetpiling 10 to 15 ft. in length. These are for use in protecting weak places as they may develop during floods.
2. Patrolling of the dike on a regular schedule—day and night—from the time the river reaches El. 80 on the Caledonia gage until it recedes below that point. In this connection see Fig. 3.
3. Elimination by drainage of all lakes accessible to the drainage system.
4. In remaining lakes, practice of systematic trapping each year to keep down muskrats.
5. With respect to present lakes a careful examination of the adjacent embankment for penetrating muskrat holes or "runs," and the thorough repair of those that may be found.
6. The encouragement of honeysuckle, willow and cane growth between the dike and the river bank, leaving some 50 ft. in front of the dike free of willow, cane or other shrub growth, honeysuckle and grass being encouraged in this area.
7. Prevention of shrub growth on the dike proper, but the maintenance at all times of an unbroken turf. "Burning off" is to be discouraged.

Personnel

The investigations and work described were carried on under the direction of Thorndike Saville, chief engineer, North Carolina department of conservation and development until his resignation in August, 1932, when he was succeeded by Charles E. Ray, Jr. Mr. Saville remained as consultant to the department, of which Colonel J. W. Harrelson was director during the progress of the work. Throughout the work George Ross Pou was superintendent of the state prison, and Captain N. E. Ranes was local warden in charge of the farm. The resident engineer on the work throughout the period of construction was P. L. Abernethy.

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Welded Corrugated-Iron Roof for a Calcining Building

A new welded corrugated-iron roof over a calcining building of the Republic Carbon Co., Niagara Falls, N. Y., represents one of the first installations of this kind on record. Lap welds are used, made with a heavy flux-coated iron rod of the same composition as the roofing. Expansion joints are placed at intervals of 28 ft., the space between the lapping and along the exposed edge being covered with glazing cement. According to the Republic Steel Corp., whose Toncan iron was used to resist the acid fumes of the calcining operations, some 17½ tons of 12-gage sheet were required, coated on the under side with an asphaltic compound and on the outside with a special aluminum asphalt paint.

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[1] "The Design of Earth Dams" by Joel D. Justin, *Trans., Am.Soc.C.E.*, 1922. "Material in Existing Earth Dams," by E. W. Lane, *Engineering News-Record*, Dec. 18, 1930.

Heating Water-Tank Risers by Electricity

By J. N. Laycock
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ORDINARILY, small copper conductors carrying light currents such as are carried by house wiring are thought of as producing a negligible amount of heat. They do, however, produce an amount of heat which is equivalent to the energy loss in the passage of the electric current through them. Two installations employing this principle were completed by the Navy Department Bureau of Yards and Docks at the beginning of the past winter season to heat the riser pipes of two elevated water tanks at a naval station in New England and prevent their freezing. Two heating elements were wound spirally on each riser, each element consisting of a two-conductor copper-cable, No. 14 A.G.G., which was varnished-cloth-insulated and lead-sheathed. The two conductors of each cable were spliced at one end, making each element in effect 2,500 ft. of No. 14 copper conductor with inductance practically eliminated.

The two elevated tanks whose risers were so treated are: (1) the "North High" tank, which has a capacity of 200,000 gal. in stationary reserve. This tank has a 10-in. flanged cast-iron riser 86 ft. above ground; and (2) the "Camp Hingham" tank, which is of 200,000-gal. capacity, floating on the fire mains, with an 8-in. flanged cast-iron riser 45 ft. above ground.

The installation was made under contract. Two reels, each holding 1,250 ft. of the two-conductor copper cable, were delivered to each tank. A full-height scaffolding was erected far enough from the riser to allow the cable reels to pass between the staging and the bare riser pipe at any point. The old wood frost casings were removed from the risers. A circular trolley track was erected around the riser under the permanent steel platform at the top of the riser, and two trolleys were placed thereon. Each of the cable reels was hoisted up to its trolley, and the simultaneous winding of both conductors on the riser was carried out by rotating the reels around the riser, spacing the turns a predetermined distance. The conductors were bound to the riser at intervals of not more than 5 ft. by insulated copper wire bands. The placing of these bands necessitated winding the two conductors simultaneously. Surfaces on the riser pipes likely to damage the lead sheathing of the cable, such as bolted flanges and expansion joints, were covered with sheet-metal forms with lugs to prevent slipping of the cable.

The windings were covered with tightly wrapped asphalt-saturated asbestos paper lapped in the direction to prevent sweat from the pipe getting to the heat insulation. This paper was bound in place by annealed brass wire bands. Two layers of 1½-in.-thick hair felt (standard specification 32F2) were then applied, breaking joints. Each layer of felt was secured with annealed brass wire, twisted tightly over wooden battens. The felt was covered with building paper reinforced with embedded string, shingled to shed water from the felt, and wired in place. The whole was covered with a 20-gage galvanized sheet-metal casing.

A steel angle formed into a ring with a down-standing leg was welded to the hemispherical bottom of the tank just outside the limits of the riser casing to act as a counterflashing and to cause the drip from the bottom of the tank to fall outside the sheet-metal covering of the riser casing.

Such an installation on a flanged-pipe 10-in. riser 86 ft. high is estimated to cost about $1,600 at present prices.

A No. 14 copper conductor at 77 deg. F. has a resistance of 2.576 ohms per 1,000 ft., or 6.44 ohms in 2,500 ft. With 115 volts impressed on the ends of the 2,500-ft. conductor, $\frac{115}{6.44} = 17.9$ amps. will flow through the conductor, which is safely within its carrying capacity with varnished-cloth insulation. The 2,500 ft. of conductor may, therefore, be directly connected across 115 volts without injury, and when so connected it will consume $17.9 \times 115 = 2{,}060$ watts.

One watt-hour equals 3.415 B.t.u. The 2,060 watts are, therefore, equal to 7,035 B.t.u. per hour.

Heat losses

A 10-in riser pipe with heating element wound on it, which in turn is tightly clamped with 3 in. of hair-felt insulation, would have an outside diameter of about 17 in. Hair felt 1 in. thick has a conductivity of about 0.40 B.t.u. per sq.ft. per hour per degree temperature difference. For a 10-in. riser 86 ft. high with 3 in. of hair-felt insulation the loss of heat with a 50 deg. temperature difference would be $50 \times \frac{0.40}{3} \times \frac{17}{12} \pi \times 86 = 2{,}550$ B.t.u. per hour.

The 7,035 B.t.u. per hour provided by the 2,500 ft. of No. 14 copper conductor across 115 volts has a factor of safety of nearly 2.8 so far as radiation alone is concerned. There will tend to be some loss of heat by conduction and convection to the tank and ground. The delivery of some heat into the tank to retard formation of ice on the tank and water surfaces is advisable. The formation of ice on the top surface of the water in a tank may cause failure of the tank when water is pumped in or drawn out. The formation of such ice in these tanks is being observed to determine whether any special provisions of procedure or construction are needed.

Automatic control

The two conductors on each riser were connected by means of thermostats, relays and magnetic switches to perform automatically as follows:

For outdoor temperatures between 35 and 20 deg. F., the two elements are operated in series across 115 volts, taking about 1,000 watts and producing about 3,500 B.t.u. per hour.

For temperatures between 20 and 10 deg. F., one element is connected across 115 volts, taking about 2,000 watts and producing about 7,000 B.t.u. per hour.

For temperatures below 10 deg. F., two conductors are connected in series across 230 volts, consuming about 4,000 watts and producing about 14,000 B.t.u. per hour.

Power costs

The North High tank, which carries one of these installations, consumed therein 649 kw.-hr. of power between Dec. 19, 1932, and March, 1933, which at $0.03713 per kw.-hr. amounts to $24.10, or about $8 per month. This was, however, a moderate winter, and the station opened the disconnect switches during warm spells. The "Camp Hingham" tank in another part of the reservation was disconnected less frequently, and the power consumption between the same dates was 875 kw.-hr., amounting to $32.49, or about $11 per month.

The water at the bottom of the riser, with the water at rest, in some cases rose to 70 deg. F., while the water at the top was but little above freezing. It is apparent that there is little convection in quiescent water in a 10-in. riser 86 ft. high. The same applies to air in a sealed vertical tube, as was evidenced by the experience with an experimental electric heating installation in which the electric heat was applied by snow melters at the bottom of a 34-in. riser casing. Very sluggish convection is to be expected unless the rising and descending currents are kept apart in separate channels. The warm rising currents of air or water meeting cold descending currents in the same tube are mixed with them. In thus mixing, both hot and cold currents quickly lose their identity, and the forces of the convection are nullified with very little movement of air or water.

The water temperature at the top of the riser (about 3 ft. below the tank bottom) ran between 32 deg. and 43 deg. F. (most of the time between 33 and 37 deg. F.). At the bottom of the risers the water temperature ran between 32 and 74 deg. F. (most of the time between 36 and 41 deg. F.).

Conflict Over Formal Agreements Delays Reclamation Work

WORK on most of the 28 projects for which the Public Works Administration has allocated $103,875,000 to the U. S. Bureau of Reclamation has been delayed or entirely held up through conflict between parties interested in the projects or through failure to complete negotiation of the repayment agreements. Experience indicates that reclamation projects, like most other public-works projects, cannot be expedited if the normal government safeguards are to be maintained. Also, the emergency program in the reclamation field is confronted by much the same conditions and is held up by the same complications that have delayed such work in the past. Only on projects such as Boulder Dam and Owyhee where allotments have been made to continue work already under way has it been possible to put the emergency funds into use quickly.

Details of the total allotment of $103,875,000 are given in the accompanying table. Almost 70 per cent of the total is accounted for by allotments of $38,025,000 to Boulder Dam, $15,000,000 to the Grand Coulee power project on the Columbia River, $12,000,000 to the Casper-Alcova power and irrigation project in Wyoming, and $6,000,000 to the All-American Canal in the Imperial Valley of Southern California.

As noted above, work on Boulder Dam and on the Owyhee irrigation project is making satisfactory progress. On the other projects for which the government has set aside large sums the following is the status of the undertaking:

Grand Coulee, Wash.—Construction of a dam across the Columbia River to part of the height required for full development of the Grand Coulee power and irrigation project has been begun, a contract having been let some time ago for clearing the dam site. The present plans are for power development only. The project was inaugurated by the Columbia Basin Commission as a state project under an allotment of $63,000,000 but subsequently was taken over as a federal project under the Bureau of Reclamation, and the allotment was reduced to $15,000,000.

ALLOTMENTS BY PWA TO THE BUREAU OF RECLAMATION

Boulder Dam	$ 38,025,000
All-American Canal	6,000,000
Deer Creek (Provo)	2,700,000
Grand Coulee	15,000,000
Moon Lake	1,500,000
Owyhee	5,000,000
Ellenburg	60,000
Parker-Gila	100,000
Ronald	50,000
Vale	1,000,000
Casper-Alcova	12,000,000
Sanpete	300,000
Verde	4,000,000
Yuma	120,000
Boise	100,000
Upper Snake	4,000,000
Bitter Root	100,000
Milk River	65,000
Chain Lakes	2,000,000
Sun River	600,000
Minidoka (Gooding Div.)	400,000
Upper Truckee	1,500,000
Humboldt	2,000,000
Rio Grande	500,000
Stanfield	100,000
Hyrum	930,000
Ogden	3,000,000
Uncompaghre	2,725,000
	$103,875,000
Industrial survey of Boulder Dam area	25,000

Casper-Alcova, Wyo.—The PWA allotment of $12,000,000 (originally $22,700,000) covers both the Casper-Alcova irrigation project and the Seminole Dam, a power and water-storage project on the North Platte River. A contract for the diversion tunnel at the dam for the Casper-Alcova project has been let, and work on the dam and canals is expected to begin early in the spring.

All-American Canal, Calif.—A diversion dam on the Colorado River with a canal to divert 15,000 sec.-ft. to the Imperial Valley in California is included under the PWA allotment of $6,000,000 against a total cost of $27,000,000. Bids received Dec. 20 for the first section of the canal were rejected as too high, also because Comptroller-General McCarl ruled that until litigation involving the contract between the government and the Imperial Irrigation District is settled, no disbursements may be made.

Provo, Utah—The PWA has allotted $2,700,000 against an estimated total cost of $5,400,000 for the Deer Creek Reservoir, 12 miles above Provo, to impound 140,000 acre-ft. The project is awaiting agreement among various interests and negotiation of repayment contract.

Upper Snake River, Idaho—Exploratory boring is in progress on Henrys Fork, a few miles below Henrys Lake, as exploration in 1922 at the original site on Teton River disclosed cavities in the rock. For the dam, impounding about 150,000 acre-ft., PWA allotted $4,000,000.

Chain Lakes, Mont.—Foundation at the new site appears to be good for a reservoir impounding 50,000 acre-ft. to augment the supply from the St. Mary River. PWA allotted $2,000,000 and the contract will be let soon.

Upper Truckee River, Nev.—Construction of a 43,000-acre-ft. reservoir, for which PWA allotted $1,500,000 to provide additional water in the vicinity of Reno, is awaiting agreement among farmers on the Truckee-Carson project, an independent group of irrigators and power interests.

Humboldt River, Nev.—Construction of a 70,000-acre-ft. reservoir near Imlay, for which PWA allotted $2,000,000 is held up by disagreement as between two sites, Callahan and Rye Patch, and execution of the repayment contract by Pershing County Water Conservation District.

Ogden River, Utah—Preliminaries involve abandonment of the electric railroad crossing the Pine View Dam site, obtaining rights-of-way for canals and arranging for the use of the pipe line of the Utah Power & Light Co., to be enlarged to 280 sec.-ft. The dam for which PWA allotted $3,000,000 will have a capacity of 38,000 acre.-ft.

Verde River, Ariz.—Surveys and condemnation proceedings are under way for two storage and one diversion dam on Verde River and a 55-mile canal to the Paradise-Verde Irrigation District. PWA advanced $4,000,000 against a total estimated cost of $19,000,000.

Owyhee Project Progress Notes

CONSTRUCTION of the distribution system of the Owyhee project is progressing rapidly under the $5,000,000 allotment from NRA public-works funds. The present program contemplates the possibility of watering some of the lands under the Kingman and Mitchell Butte laterals in 1935 and continuing the North Canal on to completion as rapidly as possible; after which the South Canal system, serving the Gem District, is to be built.

The North Canal, serving the laterals of the Mitchell Butte Division and the Dead Ox Flat Division, north of the Malheur River, runs northward from the Tunnel Canyon outlet of 3½-mile Tunnel No. 1, which, with the $6,000,000 Owyhee Dam, has been completed. It will cross the Owyhee River beyond the Kingman Lateral turnout with a 9-ft.-diameter steel siphon, 1,600 ft. long, under 300-ft. head, and will cross the Malheur River with a 4½-mile siphon. Along the line between Tunnel Canyon and the Malheur River are seven other large siphons, three tunnels and many concrete structures, including turnouts, culverts and wasteways.

The earthwork has been completed as far as Mitchell Butte, 9½ miles, and contracts have been let for the intervening structures such as Tunnel Canyon Division Works, Black Willow, Snivley, Owyhee River and Rock Springs Creek siphons. These are scheduled for completion in 1934. North of Mitchell Butte 29 miles of main canal earthwork is under contract, and the 11 miles of earthwork on the Mitchell Butte Lateral, which serves the Ontario-Nyssa Canal, is just completed.

Winter Work Emphasized at Concrete Meeting

Program of annual convention of American Concrete Institute in Toronto also includes papers on concrete durability, evaluating admixtures, high-silica cements, architectural concrete, construction-joint technique, plastic flow and bridges

MEETING outside of the United States for the first time in its 30 years of existence, the American Concrete Institute held its annual convention in Toronto, Canada, on Feb. 20-22. Of nearly 400 who registered, considerably more than half were Canadians. As befitting the time of year and the climate of the locality, a session on winter concreting formed an outstanding part of the program. It was also fitting that the chairman of the local committee handling the convention, R. B. Young, should have contributed prominently to the program of this winter-concreting session. A second high spot on the program was a session on architectural concrete featuring a paper by John J. Early, architectural sculptor of Washington, D. C. The research reports, while not quite so spectacular as the Boulder Dam and vibration studies at last year's convention, were uniformly good and significant, concerning such subjects as concrete durability, admixtures, plastic flow and bond at construction joints.

Arthur R. Lord, consulting engineer, Chicago, was elected president, succeeding Prof. S. C. Hollister, of Purdue University. F. R. McMillan, director of research, Portland Cement Association, was elected vice-president. The Henry C. Turner gold medal awarded "for notable achievement in or service to the concrete industry" was awarded to John J. Early for "outstanding achievement in developing concrete as an architectural medium." Previous recipients of this award, first made in 1927, have been W. K. Hatt, Arthur N. Talbot, F. E. Turneaure and Duff A. Abrams. The Leonard C. Wason Bronze Medal was awarded to L. Boyd Mercer, of Melbourne, Australia, for his paper of last year on "Sliding Formwork."

The health of the Institute, as measured by membership, financial assets, committee activities and accomplishments, has remained uniformly good in spite of difficult conditions.

Concrete durability

Durability of concrete, with special reference to aggregates, was considered in papers by Inge Lyse, Lehigh University, and E. Viens, director, testing laboratories, Canadian department of public works. Professor Lyse described a test program involving six natural sands and gravels, three limestones and a combination of crushed iron ore and steel punchings. Three mixes were made with each kind of aggregates, each subjected to three periods of moist curing. Both cylinders and aggregates were tested in freezing and thawing and in sodium sulphate solution, as a measure of durability. The cylinders were also tested in compression. In general, both strength and durability of the concrete increased in direct proportion to the increase in the cement-water-ratio of the paste regardless of aggregate used, but for the same paste the limestone aggregates were the least durable. Durability (measured by the number of cycles of freezing and thawing required to reduce the weight 25 per cent) was shown to increase very rapidly between the ages of 3 and 7 days, under moist curing, while the increase between 7 and 28 days was relatively small. Professor Lyse concluded that "The durability of concrete is an economic problem and can be obtained by the use of high-grade aggregates in good quality paste, or by a less high-grade aggregate in high-quality paste, or by the use of low-quality paste with long curing, or high-quality paste with short curing."

Mr. Viens also spoke in favor of good-quality paste for exposed concrete. The same aggregate that would initiate failure in a 2,000-lb. concrete might be quite satisfactory in a 3,000- or 4,000-lb. concrete, he said. On the other hand, there are aggregates that will lead to concrete failure regardless of the strength of concrete. Both speakers implied that durability of concrete is best measured on the concrete itself and is not necessarily indicated by merely measuring aggregate durability.

Precast joist floors

The utilization in some recent residences of floors made up of precast joists and a poured slab raises the question of the efficiency of the interaction of the two elements. R. E. Copeland, technical engineer, Portland Cement Association, described some load tests made on seventeen 4x14-ft. panels in which joists of a general I-section shape, 8 in. deep with 3-in.-wide flanges and 1¼-in.-thick webs, were used. Reinforcement consisted of a single rod top and bottom and stirrups, which in some cases extended above the top of the joist to provide a metal tie with the poured slab. In other tests, concrete bond alone was relied upon as a tie. The results indicated that metal ties were not necessary. All panels, regardless of type of joint, failed gradually in tension and under loads varying from 2.8 to 3.7 times an assumed 85-lb. live load. Slabs of 2,000- and 4,000-lb. concrete acted similarly. Whether the aggregates in slab or joist were stone or cinders was not found to be important. In general, the tests indicated that the interaction of slabs and joists was good enough to warrant designing such floors by conventional T-beam methods.

Architectural concrete

Three papers at the second session centered on the subject of the architectural possibilities in concrete. Alfred Chapman of Toronto represented the architect's problem as being particularly difficult because he is in the position of using his client's money for experimental purposes. In evaluating the architectural excellence of existing concrete structures, Mr. Chapman placed first those which obviously express the construction—namely, a cast monolith.

The second paper, by Walter T. Steilberg, architect of Berkeley, Calif., was briefly presented by Arthur R. Lord in the absence of the author. Mr. Steilberg listed the three alternatives in using concrete in buildings: (1) conceal or disguise it, by a facing or inclosure of some sort; (2) utilize it, for economy or other reasons, to secure a certain style of architecture, largely regardless of its inherent characteristics; and (3) emphasize it strongly by monolithic surfaces, prominent arches, ribs, etc. Mr. Steilberg, after emphasizing the leadership of the West Coast in utilizing concrete in buildings, took exception to the view that West Coast climate is kind to concrete, contending that the extreme variation in moisture conditions in that region is quite as harmful as temperature variations in other parts of the country.

In the third paper, John J. Early reviewed the remarkable development in architectural concrete of the exposed and polychrome aggregate type that has occurred in the work of his studio in Washington, D. C., culminating, at present, in the Baha'i Temple dome at Wilmette, Ill., and the hallway ceilings in the new Department of Justice Building in Washington.

Each important advance has occurred as a result of concentrated attention on the requirements of some particular structure. Thus, from the Meridian Hill Park work in Washington emerged the method of controlling the appearance of exposed aggregate by means of a two-step gradation of the aggregates in which they are first separated into fine, medium and coarse, after which the medium size is eliminated. Better uniformity, strength, and workability result, the latter permitting the filling of complicated molds. On Lorado Taft's Fountain of Time in Chicago absorptive cores were made a part of the mold, and these cores extracted the free water, permitting concrete to be placed in a wet consistency and to set in a dryer one, eliminating shrinkage. A third advance occurred on the Church of the Sacred Heart at Washington, where mosaic patterns in the aggregate were first achieved; raised contour lines in the molds separated the various-colored aggregates and held them in exact position. The most recent development occurred in the Department of Justice Building in Washington, where thin precast slabs of concrete mosaic were used as forms for the structural concrete.

A fifth development emerged from the construction of the concrete tracery dome recently completed for the Baha'i Temple. This consisted in developing a high-early-strength concrete by the unusual expedient of increasing the size of the small aggregates by only such a minute amount as is represented by the difference between a 0.0125 and a 0.014 sieve opening. The principle upon which this is based is that by increasing the size of the small aggregate particles, fewer aggregates are used and therefore the amount of aggregate surface is reduced. As a consequence, the amount of water that will be held in the concrete against capillary pull is reduced. By placing cotton cloth over the concrete to extract the water by capillary pull and covering the cloth with fine screenings to absorb the water, an almost dry mix was produced in the molds. Mr. Early completed his paper by describing the remarkably ingenious craftsmanship which produced the complicated and exceedingly accurate tracery of the exposed-aggregate slabs and ribs of the 100-ft.-diameter dome of the temple.

Winter concreting

Field practices, as rationalized in the practices of the Ontario Hydro Electric Power Commission, were described in a session devoted to winter concreting in two papers under the joint authorship of R. B. Young and Wilfrid Schnarr. Three divisions of the work were recognized: (1) preparing the ingredients; (2) placing concrete in the forms; and (3) weather protection in the forms. Necessary differences between mass concrete and reinforced-concrete requirements were also considered. A few of the many conclusions follow:

In supplying heat to the ingredients, the water is the best and probably the only ingredient that can be counted efficient; it stores heat readily and is heated easily. Sand should be thawed out but need not be over 40 deg. temperature; a system of steam pipes bordering the supply tunnel under a stockpile is often very efficient. Provided there is no ice present, the temperature of the aggregates need not cause concern. In thawing them out, when required, steam which surrounds the stones and is quite mobile is preferable to dry heat, which usually is too localized in effect. Condensation from steam-heating of sand and stone does not increase the water content of the aggregates except in the bottom layers of stockpiles; by using material from the top of the pile the wet aggregate can be avoided. In aggregate bins the heat previously supplied in stockpiles can be temporarily maintained by steam pipes around the bins; in this case dry heat is preferable to steam jets because the material is used from the bottom of the bin where condensate would collect. Water can be heated as high as 180 deg., but concrete that is too hot causes a fog that is difficult to work in, and hot concrete also loses its plasticity at a rapid rate. Boiler water may be used, or water may be heated by steam coils or by live steam. The most important and necessary precaution is to provide a water supply large enough and a tank of generous proportions for storing it.

In transporting concrete to forms, metal chutes and buggies are quite satisfactory and do not cause as much heat loss as might be supposed; from 2 to 5 deg. seems to be the maximum loss for reasonable distances of transport. In zero weather, chutes or belts, if used, should be heated or covered to eliminate the thin film of ice that tends to form. Heat losses in transporting ready-mixed concrete are also small, perhaps on the order of 5 deg.; without fear of more than a 10 deg. loss in heat, concrete can be hauled in a closed truck for an hour in zero weather.

In protecting concrete in forms it is necessary to recognize that mass concrete needs protection only against frost on the surface, while slender members must be carefully controlled for high-early-strength development. Wood forms are better than steel forms; two layers of wood forms with a dead air space between are especially efficient. Lumber ⅞ in. thick is the maximum that is economical or practical. A single ⅞-in. form will protect 70-deg. concrete for two hours at air temperatures of 10 deg. below zero, and for six hours at temperatures of 26 deg. above zero, according to some recent tests. Mass concrete should have a minimum temperature of 50 deg. at placing, and other concrete of 60 to 70 deg. Tight tarpaulins with steam heat beneath give the best protection. Special care should be exercised at corners of forms to maintain a reasonable temperature. A good procedure is to determine critical points, such as corners, and concentrate temperature readings there, on the assumption that the rest of the structure will always be warmer. The authors have placed concrete at 40 deg. below zero and consistently at zero, with minimum expense and uniformly good results in following the above simple practices.

A third paper in this session, allied to winter concreting, gave results of a laboratory investigation of temperature effects on concrete strengths. Written by A. G. Timms and N. H. Withey, of the Portland Cement Association, it was presented by H. F. Gonnerman. In the study, 3x6-in. specimens made with both normal portland and high-early-strength cements and water contents of 4½, 6 and 9 gal. of water per sack of cement were used, with mixes being made of the same consistency throughout. The specimens were exposed to air temperatures of 50, 33 and 16 deg. F. after moist curing at the temperature of pouring (either 70 or 50 deg. F.) for various lengths of time. After the cooling period, some of the specimens were warmed in 70 deg. air for different lengths of time. Among the conclusions drawn and the results of the tests were the following:

1. The strength gain of the concrete following a given initial curing was dependent on the temperature of exposure. The 28-day strengths obtained in temperatures of 50 and 33 deg. F. were in general from 50 to 75 per cent of those obtained with concrete moist-cured for 28 days at 70 deg. F. The rate of gain in strength with age was less for concrete exposed to 33 deg. F. than to 50 deg. F. At 16 deg. F. the richest mix showed a definite gain in strength, but the other mixes gained only slightly.
2. Subsequent warming of concrete exposed to temperatures of 50 and 33 deg. was not of much benefit in improving the later strengths when no provision was made to supply moisture to further the curing action. The greatest benefit from warming occurred with the concrete exposed at 16 deg. F.
3. The importance of the duration of the period of initial curing was brought out strikingly in the tests. The indications were that when the temperature of exposure is from 33 to 50 deg. F., the initial curing period of 70 deg. F. should be at least 3 days for normal cement and at least 1 day for high-early-strength cement. For below-freezing exposure the initial curing period should be lengthened, depending upon the strength required for safety. For concretes exposed to temperatures below freezing the strength at any time after the period of initial curing depends primarily on the strength developed during the initial curing period.
4. Concrete to be exposed to temperatures below freezing should not be placed at a temperature of less than 70 deg. F.

In discussion of the paper D. S. MacBride (International Cement Corp.) raised the question as to why winter-concreting procedures might not better be based on the temperatures of concrete than on the temperatures of the air. He also presented the data given in the paper in a form which compared directly the strengths of the high-early-strength concretes with those of the normal portland cement concretes. His graphs indicated that for exposures of 50 and 33 deg., one-day moist curing at 70 deg. F. of high-early-strength-cement concrete produces generally higher strength at all ages than three days' curing of normal portland cement concrete. At 16 deg. temperature the curing period of high-early-strength concrete should be lengthened to from 36 to 48 hours, and to about 5 days for normal portland cement concrete, in Mr. MacBride's opinion. The data also indicate that high-early-strength concrete made at 70 deg. and cured at that temperature for one day and then exposed to 33 deg. developed a 7-day strength of 60 to 67 per cent of the 28-day moist-cured value for normal portland cement concrete. On the other hand, normal cement concrete developed a 7-day strength, after being cured 3 days at 70 deg., of 42 to 50 per cent of its 28-day moist-cured value.

Admixtures

The results of a test investigation of concrete admixtures that has been under way for two years by the Portland Cement Association was outlined by F. R. McMillan, director of research. It was the purpose of the study to secure data that would permit an economic evaluation, on the basis of concrete strength, of the replacement of various amounts of cement in a mix with each of a dozen or more of the well-known types of admixtures. The philosophy upon which the test program was developed was that the quantity and consistency of the paste are basically more important than the components of the paste and that the importance of admixtures rests only in any economy that can be effected by their use.

All mixes were made with as nearly identical properties, such as mortar voids, aggregate gradings and paste consistency, as possible. To eliminate the paste consistency variable, a method of measuring the rate of flow of the cement and cement-admixture pastes through an orifice was developed. Three mixes were used, with paste contents of 27.8, 25 and 24 per cent, respectively. Then various amounts of cement were replaced by admixtures, keeping the paste content and other characteristics constant, and test cylinders were made and tested. By plotting the results it was possible to pick off the cement-admixture combinations that would produce a desired strength with any of the three paste contents. The least costly combination could then be chosen. In the paper a series of index numbers was computed to show the comparative economic value of using the various combinations tested. Also an evaluation of relative workability of the mixes, based on remolding effort, was given.

In the course of the presentation Mr. McMillan also stated a number of conclusions relative to using admixtures. Some of them were as follows: The physical effect of adding admixtures will depend upon the original condition of the mix; they are detrimental in dry mixes and may or may not be beneficial in wetter mixes. Admixtures are most effective in low-strength concretes. Aggregate gradation is the most important factor in securing workability, and the use of additional cement or of an admixture should only be employed as a last resort.

A paper somewhat allied to admixtures was presented by Prof. Raymond E. Davis, University of California, in which the properties of mortars and concrete using high-silica cements of puzzolana type were stated in general and a new series of tests just started in the University of California laboratories was outlined. High-silica cements, according to Professor Davis, seem to have advantages over normal portlands in such factors as lower heat of hydration, greater workability, less leaching, higher early strength, smaller volume change, and perhaps lower cost if siliceous materials are readily available. A major disadvantage is that concrete using high-silica cement requires a relatively long period of moist-curing. In the new tests some of the above characteristics will be examined, using Fresno pumacite, crushed granite, diatomaceous shale (such as is being used in the cement for the Golden Gate Bridge), celite, siliceous clay, etc., as the silica ingredient. These materials will be used in both the calcined and the uncalcined state. In some cements they will be mixed with normal portland cement, and in others they will be interground.

Concrete design in France

Ben Moreell, C.E.C., U. S. Navy, who has recently returned from a year spent in studying concrete practice in France, outlined some of the design practices which differ appreciably from those in this country. The French designer is an individualist, and specifications permit his ingenuity full play. He dislikes empirical formulas and charts and relies more on theoretical considerations than on test results. Higher elastic-limit steels are coming into use in France for compression members; Freyssinet proposes a 250,000-lb. elastic-limit steel for spirals. The water-cement ratio is not especially favored as a means for predetermining strength, on the ground that the water required for pouring is usually in excess of that necessary for hydration; excess water is in fact permitted, provided it is pressed out by compacting. Round aggregate particles are favored. Curing does not receive the attention in France that it does here. In columns, square cross-section spirals are permitted but with a lower effectiveness ratio than for circular spirals; the ratio for the latter is about the same as determined in the recent A.C.I. column tests—namely, 2 to 2.2.

Commander Moreell is working on the development of designs of a three-hinged concrete-arch roof of 110-ft. span and 24.5-ft. rise. This roof will be some 1,070 ft. long, to cover a ship-model testing basin for the Navy in Washington, D. C. The hinges used will be the semi-articulated joints developed by the French engineer, Augustin Mesnager, and used on concrete bridges with spans up to 185 ft. A part of the project will also be an office building in which the transverse bents will be three-story clear-span concrete rigid frames.

Construction joints

Lively discussion centered on a paper, also by Professor Davis, presenting the results of a laboratory investigation at the University of California on the relative efficiency of bonding methods at horizontal construction joints in mass concrete. Specimens were prisms 2½x2½x5 ft. high. Three series of tests were run to determine: (1) permeability along joints; (2) bond stress (by a flexure test); (3) quality of concrete as indicated by strength, unit weight and absorption. Three methods of compacting were used: (1) hand tamping; (2) internal vibration; and (3) internal vibration followed by surface vibration at the joint. Cleaning of the joints was done in three ways: (1) by wire brushing; (2) by air and water jets between the time of initial and final set; and (3) by air and water jets after final set, so that no paste would be removed. In some specimens the joints were left clean, while in others a mortar layer was applied before the top lift of concrete was poured.

Among the results noted was that the method of placing affected the bonding; the vibrated concrete had a joint strength, as measured by the modulus of rupture of the specimens, of 112 to 200 per cent of the hand-tamped specimens. The use of air and water jets gave much better results than wire brushing, and it was concluded that the latter method was practically useless on mass concrete. The best method of treating joints was by using air and water jets between initial and final set. About six hours after pouring proved to be the best time to use the jet, just the proper amount of paste being removed to provide optimum bond. The addition of a mortar layer was found to be of no benefit. The use of surface vibrators following the use of internal vibrators was found to be neither necessary nor beneficial. Permeability was found to be least for joints prepared with the jet about six hours after the concrete was placed. Both strength and permeability were better when the second lift was poured 12 days after the first lift than they were when only a 3-day interval was used between pours. On the other hand, proper bond strength could only be obtained by maintaining the surface moist. The bond strength was found to be lowered by air-drying, even for the short time of one-half hour.

In discussion of the paper John J. Early said he felt strongly that wire brushing should not be so summarily condemned, and that while it might not be satisfactory for mass concrete work it was by far the best method of preparing joints in reinforced-concrete members and in his architectural work. F. R. McMillan also pointed to the entirely successful use of wire-brushed joints in building concrete ships. He stated it as his opinion that in mass concrete the use of heavy brooms probably disturbed the bedment of the aggregate and thus contributed to weak joints.

Plastic flow

The results of tests of ten reinforced-concrete rigid frames subjected to sustained loads for a period of two years and observed for deflections and deformations due to shrinkage and plastic flow were reported by Prof. F. E. Richart, University of Illinois. Of the frames, which were 5 ft. 9½ in. high and 7 ft. 7 in. wide, two were of closed rectangular type and the remainder were two-legged U-frames hinged at the base. The amount of compressive reinforcement and the size of the columns were different in the several frames. Initial strain readings were taken before and after loading to provide the ordinary values of elastic deformation, to be compared with the later observations of deformation under sustained loading. Readings were taken at fairly close intervals during the first four months of loading; then, with a decided decrease in the rate of flow, the readings were taken less frequently. The concrete in the frames had a strength of about 3,500 lb. per sq.in., and loads were applied to produce maximum computed working stresses of about 20,000 lb. per sq.in. in the tensile steel and 1,400 lb. per sq.in. in the concrete.

The test results showed that the ratio of final to initial values of deflection, rotation of joints and compressive strains in concrete and steel ranged roughly from 3 to 6. The stress in compressive reinforcing reached 40,000 lb. per sq.in., and compressive unit strains in concrete of 0.0025 were observed. The increase in tensile steel stress was relatively low, with an average ratio of final to initial stress of 1.8. Of the changes noted, about seven-eighths of the two-year value occurred in the first four months of the loading period. Changes in distribution between positive and negative moments were found in general to be so small and irregular as to be considered negligible.

An important result of these tests was to show that of the total effect of shrinkage and plastic flow, the latter accounted for two-thirds to four-fifths of the total. Professor Richart concluded that the time-yield effect will apparently not endanger the safety of reinforced-concrete members designed by current methods, if compression steel is properly embedded and tied in. He also stated that present methods of design for eccentrically loaded columns involved the most uncertainty as to time-yield effect, and that they should be reviewed.

In presenting the results of tests on five heavily reinforced T-beams in a study of bond, anchorage and shear, Prof. T. D. Mylrea, Carnegie Institute of Technology, Pittsburgh, pointed out the interesting possibilities in using high-elastic-limit steel. For example, building codes permit beam deflections of 1/360 of the span (as being safe for plaster), but loads that will produce such a deflection in concrete beams will cause failure in beams reinforced with the type of steel now generally used. High-strength steel (with elastic limits on the order of the 96,000 lb., as used by Professor Mylrea) would permit taking advantage of these deflections. On the other hand, extra special anchorage will be needed with high-strength steel to prevent slip. The tests showed that deflections are not recovered if slip occurs. They also showed that cracks were scarcely visible at a 30,000-lb. steel stress, indicating that the present 20,000-lb. stress is not a limit even with ordinary type of concrete.

Prof. H. M. Westergaard, University of Illinois, presented an interesting discussion of stress action in the vicinity of a crack in a concrete beam, in which it is indicated that the compressive strains in the direction of the beam are not proportional to the distance from the neutral axis. Also, the compressive-stress diagram above the crack is not triangular, but of the nature of a quadrant of an ellipse with the radius of curvature at the bottom of the diagram. Prof. S. C. Hollister, Purdue University, and Prof. Inge Lyse, Lehigh University, showed slides of cracked test specimens of pyralin and bakelite loaded and subjected to polarized light which seemed to give support to Professor Westergaard's theory.

Canadian bridges

The Canadian National Railways, under C. P. Disney, bridge engineer, has inaugurated a number of innovations in concrete bridge design during the past three or four years. H. S. Van Scoyoc, Canada Cement Co., showed some of these in a series of lantern slides. Among the innovations are the use of precast girders with a poured slab, the fastening of rails directly to longitudinal oak strips set in the concrete (no ballast being used), the utilization of rigid frames for railroad loadings, and the substitution of a solid concrete deck for stringers on through steel-girder bridges. Precast girder and rigid-frame bridges have also been used in two-span layouts, continuous over but not attached to a center support.

The rigid-frame bridge has also been used in some 20 locations over the past three years on the Ontario highway system, according to Arthur Sedgwick, bridge engineer of the province. The reason for favoring the rigid-frame type is that by virtue of its shallow deck the height of fill approaches may be reduced and the maximum stream opening provided. It has been the experience of the provincial highway department that for spans up to 60 ft., the rigid-frame design is cheaper than bowstring arches or girder bridges.

Two other papers covered subjects previously presented in some detail in these pages—namely, the cement investigations for Boulder Dam and the vibrating of concrete at Pine Canyon Dam. J. Morrow Oxley, architect, Toronto, reviewed the parts of the new Toronto building code that involve concrete, with particular emphasis on choice of moment coefficients for beams and methods of designing two-way slabs.

Blasting Frozen Clay Aids Excavating Job

An effective method of blasting frozen clay is described by John L. Bliss, of Bliss & Bliss, contractors, Lansing, Kan., in the August, 1933, issue of *The Explosives Engineer*. This firm had a "tight" road contract. Low prices, delays, winter weather with a heavy rain followed by drifting snow, all threatened costly operations. The water-soaked clay froze deeply. Dynamite was useless, as it blew out. It was impossible to dig holes in the frozen material. From excessive freezing, the ground cracked.

The contractor then tried the experiment of pouring black powder into a crack tamped with dry hay, with dry clay on top of the hay. The clay was then wet down, freezing at once. Upon firing, the explosion loosened all the frozen clay, enabling a start to be made in excavating. Two men were kept busy in removing the blasted-out lumps. This method was not only successful, but it lowered excavation costs.

On this same job several reinforced-concrete culverts were removed by laying a string of 40 per cent dynamite sticks end to end across the slab, covering them with wet clay. The clay froze instantly, and then the shots were fired. This broke down the slab and enabled the walls to be shot out in two operations. The contractor cautions against immersing or soaking in water explosives that are non-water-resistant.

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Chiseling and Bad Faith

THE TREASURY DEPARTMENT, in announcing the award of the contract for the superstructure of the post office annex at New York, tells the nation with smug satisfaction that by the fourth call for bids, the one upon which the award is made, it has saved $105,000. What it did not tell the public was that the two latest calls for bids on the post office annex either were "chiseling" upon the part of the federal government or were a deliberate attempt on the part of the administration to eliminate a bidder. When the second set of bids was opened the George F. Driscoll Co., of Brooklyn, was low bidder. After the bids were opened the Treasury Department announced that there was some question as to the eligibility of this concern because it had not signed the President's Re-employment Agreement at the time its bid was made (although it had signed by the time the bids were opened), but the department was checked in its plan to award the contract to the second low bidder by a flat statement from the Comptroller-General that he would not stand for such hairsplitting. To get out of an awkward position, the department made some changes in the specifications and called for new bids. Again the Driscoll company was low. Again the bids were rejected, and with no major changes in specifications, the fourth bids were called for. This time the Driscoll company was second by a small margin, and the award has been made to the low bidder. We commend this whole matter to the attention of Secretary Ickes in his capacity as Administrator of the PWA, under which the post office is financed. He was outspoken in his criticism of contractors at the A.G.C. meeting on the subject of chiseling and other evils of the contracting business. What does he say to the Treasury Department's chiseling?

Winter Concreting

THOSE ENGINEERS AND CONTRACTORS whose radius of activity encompasses a territory subject to four to six months of hard winter must be afforded considerable amusement by the viewing-with-alarm that annually attends the idea of pouring concrete at freezing temperatures in territories of more temperate climate. In the north country, winter is taken in the stride on construction jobs, just as the rainy season is met in matter-of-course fashion in tropical countries. Work does not stop and wait for ideal weather in either case. Climate has always been a job hazard that must be overcome, and the fact that it is a cold climate does not make it unconquerable. In two papers before the American Concrete Institute convention last week, R. B. Young and Wilfrid Schnarr, of the Ontario Hydro-Electric Power Commission, outlining the methods used on their work in mixing, pouring and protecting concrete in cold weather, brought out very illuminatingly that these methods are neither difficult and burdensome nor unduly expensive. In general, they are dictated by common sense and not by scientific finding. They are such as could be applied to any job by any contractor. And they have been effective at 40 below zero.

PWA Prospects

WITH THE END of February the regional advisors of the Public Works Administration go out of office, their uncompleted regional planning presumably to be taken over by the agents of the National Planning Board. Since the acceptance of new project applications was terminated several weeks ago, the PWA movement thus has drifted to the end of its promotional stage. The Washington staff will continue to examine projects already received, but in the absence of funds for them this will not help toward re-employment nor will it make up for the renewed unemployment resulting from the progressive release of CWA workers, already begun. So far, the PWA has put relatively few men to work. By June, when it expects to have a million men at work in the field and several million more indirectly, its contribution to the recovery job will be more effective, though still small in proportion to the gravity of the situation. Measured by the expected business-recovery impulse of its operations, the PWA on its present record cannot be described as an outstanding success. Its showing may be bettered if Congress sets up an additional fund and the administration goes determinedly to work to transmute this fund into quick employment.

Averaging Bids

MUCH HAS BEEN SAID in recent months about the advantages of letting contracts to other than the low bidder, and this journal has been urged repeatedly to advocate schemes for carrying out this purpose. It has been proposed that bids be averaged and the contract awarded to the bidder closest to the average; and, again, to throw out the high and low bids and make the award on the average of the remainder. The bids on the Midtown Hudson Tunnel at New York furnish an example of the inequity of such proposals, in some instances at least, and the difficulty involved in convincing the public that awarding the contract to other than the low bidder would be sound. On the Midtown tunnel project one of the ablest and most experienced firms of tunnel builders in the country submitted a low bid, three firms submitted bids within a few thousand dollars of each other, but all nearly a million dollars above the low bid, and a fifth firm bid nearly a million dollars higher than these three. The difference between the low bid and the next three is largely explained by the fact that the low bidder recently completed a similar job and has both plant and an experienced organization available. Any one of the many averaging schemes would have eliminated this firm's bid: the public would have been the loser and the bidder would have found his experience and equipment a handicap rather than an asset.

Bridge Traffic Terminals

HOW LARGELY the engineering of a great city bridge has become a traffic problem is emphasized by the Triborough bridge now under construction over the East River in New York City no less than by the George

Washington bridge across the Hudson to New Jersey (*ENR*, Oct. 22, 1931). In both instances the task of getting traffic across the bridge was insignificant compared with the problem of collecting it for delivery to and dispersing it for distribution from the bridge. The traffic problem of a major bridge between metropolitan areas is preeminently a terminal problem, in which each terminal is a complex traffic-collecting and distributing agency. Heavy haulage and its light business and pleasure traffic, with their different speeds, must be kept from mutual interference. In essence these statements are elementary, but when kept clearly in mind they lead to a distinctly more interesting picture of the Queens terminal and interchange intersection so clearly described in our leading article. Its intricate loopings and ramps are a little appalling at first glance, but analysis shows them to be far simpler than they appear. It is less in plan and structure than in clearness of direction to the strange driver that the modern looped intersection needs improvement.

The Case of the Employed Engineer

SINCE discussion of a code of fair competition for engineers first began, the case of the employed engineer has been a fundamental point of controversy. One reason for this is that the engineering of construction differs essentially from commodity manufacturing and trading, for the engineering employee not only carries out the service of the business but takes part also in its planning and direction, so that individual qualities rather than mass action or shop system are controlling. The problem of adapting the NRA's procedures and dogmas, which are based on commodity thinking, to the conditions of construction engineering is therefore difficult, and it is only natural that conflicts and dissatisfaction have developed.

Just now the engineer's code question is at the lowest point it has reached since the beginning of the work, seven months ago. Practically all that has been done to date in drafting a workable code is temporarily in the discard. The delays to date have killed much of the interest and enthusiasm for the code among engineers throughout the country, and the spirit of increased unity that would have been fostered by code cooperation has found little encouragement. But if, pending the development of a practical code, the employee problem can be clarified, the gain may outweigh this loss.

In considering the case of the engineering employee, the first vital fact to be kept in mind is that with rare exceptions engineering work involves a professional responsibility. What the employer wants and pays for is not so much the labor of the engineering employee as the partnership contribution of his technical experience, his judgment and his creative ability, plus unwavering integrity and impartiality. Such service is not easily fitted to conventional thinking on labor relations.

The next important fact is that, even in normal times, many employed engineers were underpaid, and their work and income lacked stability, all of which tended toward progressive deterioration of the quality of engineering service. These conditions were aggravated by the depression. Therefore, in so far as a code can serve as a remedy it should be so written and administered that it will improve and stabilize engineering employment and compensation.

A third fact of moment is that the labor of engineers depends in high degree on the secure and stable competition of practicing engineers and of other participants in construction who employ engineers as essential agents in the conduct of their work. Thus in the interest of employee as well as of employer, engineering has a real need to look for means of bringing about the "fair competition" which the Recovery Act aims to make possible. In the professional sphere of work this means, as everyone but the NRA officials recognizes, that there must be established and duly safeguarded a scale of professional service fees. Without the restraint of a reasonable fee scale the wage-chiseling employer-engineer will continue to operate.

As a matter of elementary protection, engineering labor is entitled to have its minimum rate of compensation fixed. Professional labor is as clearly justified in asking that a basement level of compensation be defined as is pick-and-shovel labor or craftsman labor. Similarly, there is justification and necessity for asking that engineering fees be guided by a fixed scale of minima, as a sound guarding of fair competition and of adequate professional performance. But for the time being, neither of these essential desiderata is possible, as the NRA officials declare them not legally permissible.

Under their rulings no wage rates other than a single minimum (which means the rate for common labor) may be specified in a code, except when both the employer and the employee groups are fully organized. And this is not the case in engineering, and is not likely to be. But in the subsequent administration of the code, local or national wage rates may be set by some means of reaching general agreement that will be equivalent in effect to the "collective bargaining" of the Recovery Act.

Thus the direct road to the sought-for objective is indicated. Though slower than the fixing of rates in the code itself, it is truer and more responsive. It is the method to which, under the present circumstances, the entire profession of construction engineering should turn its eye, so that its successful application may be realized at an early date.

The local engineering societies have an obvious part in bringing about full understanding of this situation, and in preparing the ground for framing agreements later on. And the same remark is applicable to the fee question. Though the NRA may yet take a different attitude on a fee minimum when it comes to appreciate its importance to the proper functioning of the profession, yet here as well as in the pay matter the desired end may be attained after the code is approved.

The present problem, then, is to come as near to an adequate code as the existing rules will permit: to write the best set of rules for fair, ethically and financially sound conduct as a means of safeguarding the professional and business relations of engineers, with due provision for employee agreements and for administration. And above all it is vital to shape the code to those activities and those relationships that for generations past have defined the work of the engineer as a professional activity charged with a special trust in the construction of works for human service.

CURRENT NEWS

PWA to Allot No More Funds To Private Works

IN VIEW of the exhausted status of the public works fund, the PWA has announced that it henceforth will not consider for allotments applications from private corporations, railroads excepted, limited dividend housing corporations or private schools or private eleemosynary institutions. It has been announced that allotments will continue to be made to public bodies, however, in so far as the status of funds permits.

The new policy is not to be construed to mean that no further money is to be allotted for low-cost housing and slum clearance projects. The fact is that the experience of the Housing Division of PWA has demonstrated that private initiative has failed to supply the low-cost housing that is needed. To meet this situation the PWA has allotted $100,000,000 to the Public Works Emergency Housing Corporation to undertake housing and slum clearance projects directly and to aid housing authorities created by state or municipal enactment.

PWA will continue to make loans to railroads for the purchase of rails and equipment because of the semi-public nature of the carriers and because loans of this character are quickly transformed into payrolls and are an important factor in the program to afford relief to the heavy industries.

New allotments announced

Loans and grants totaling $9,295,796 have been allotted to 91 non-federal projects. Of these allotments 73 were for loans and grants while 18 were for grants only.

The money allotted to these projects had been allotted previously to other projects which have been rescinded because of inability of the applicant to go ahead with the work planned on account of the adverse outcome of bond elections, decision of local officials to abandon the planned construction, transferring of the project to the CWA and other similar reasons.

Seventy-eight allotments of loans and grants totalling $11,635,420 which had previously been made to the state of Massachusetts for construction of non-federal projects, have been changed, at the request of the chairman of the Massachusetts Emergency Public Works Commission, to grants only, totalling $3,257,500. The changes were requested because the state has found that since the original allotments were made it will be able to furnish a part of the balance of the money necessary for construction from certain funds it now has on hand and that it also will be able to sell its bonds in the open market to raise the balance without calling on the PWA.

It has been announced also that a previously made loan and grant allotment of $700,000 to Hamden, Conn., for construction of a high school building has been changed to a grant only of $197,000 because the town has sold its bonds in the open market and will not need a PWA loan. Reductions totalling $42,597 in six other allotments also have been announced by the PWA.

The $8,923,517 released by these changes has been reallotted to other projects which were left on the waiting list when the PWA appropriation was exhausted.

An allotment of $1,462,000 has been made to the Public Works Branch of the Treasury Department for the construction or remodeling of 14 public buildings.

The Mississippi Valley Committee has been allotted $45,000 to conduct studies of flood frequency, rainfall and run-off in the Mississippi Valley. The work will be done in collaboration with the Geological Survey and will probably cover the portion of the Mississippi Valley north of the Ohio and lower Missouri rivers.

Names of projects

No project financed by public works funds is to be named without the consent of the Federal Emergency Administrator of Public Works, it has been announced, nor will any such project be named after a living person.

The Special Board for Public Works has approved the following resolution: "Resolved, that no project financed in whole or in part with funds made available by the Public Works Administration shall be named after a living person or, in any event, without the prior consent of the Federal Emergency Administrator of Public Works."

Changes in Personnel In Federal Building Program

L. W. Robert, Assistant Secretary of the Treasury, has been removed from supervision of public building construction to the Bureau of Engraving & Printing and the Mint, and Admiral C. J. Peoples, retired naval officer, has been put in charge of a new procurement division including both public building and purchase of supplies. Emergency building activity has been transferred to the Public Works Administration.

W. E. Reynolds, former technical adviser to Asst. Secretary Robert, will serve Admiral Peoples in the same capacity and L. C. Martin will remain as assistant. Other appointments incident to the reorganization include:

Supervising architect, Louis A. Simon, chief, succeeding James A. Wetmore, who has been acting supervising architect and now becomes chairman of the board of awards; George W. Stone, architecture; T. C. Brooks, structural engineering; N. S. Thompson, mechanical engineering; J. W. Ginder, architectural engineering.

Construction branch: George O. von Nerta, chief; Neal A. Mellick, construction management; George R. Roberts, project management.

Legal staff: E. R. Witman, chief; H. S. Roome, acquisition of sites.

Office management: John H. Schaeffer.

Board of Awards: Wetmore, Simon, von Nerta, Schaeffer and Witman.

Supreme Court Refuses to Review New River Power Case

The United States Supreme Court on Feb. 19 refused to pass on the right of the Federal Power Commission to license power plants on non-navigable streams, leaving the development of the Appalachian Electric Power Co. on the New River in Virginia still in a legal tangle. The company challenged the authority of the commission over small streams, objecting to a clause in the licenses granted by the commission which allows the government the right to purchase the plant at the end of the license period.

The refusal of the court to pass on the case was in line with its rule not to give advisory opinions. No actual construction had been begun by the company when the suit was filed, although it had spent about $1,500,000 in preparing to build the plant.

Improved Bond Market Noted by PWA

A strong tendency has been noted by the Record Section of the Projects Division of the PWA for applicants for loans and grants to request that their applications be changed to grants only. The reason given by most of the applicants for requesting this type of change is that they have been or will be able to sell their bonds in the private investment market and will not need to call on PWA to buy them. In making allotments of loans and grants the PWA agrees to bid par on bonds bearing 4 per cent interest, and to take the bonds at that price provided private investors do not bid the same price or a higher one. If private investors bid par on the bonds, the PWA steps aside in their favor, and if they bid a premium, they of course take the bonds by right of being the highest bidder.

Only one request was received during the first two weeks of February for a change of a grant allotment to an allotment of both a loan and grant because the applicant had been unable to sell its bonds in the open market as it had expected to do.

State Planning Board Set Up by Arkansas

A state planning board, with, as its first goal, the preparation of a preliminary plan to include a program of public works for at least 10 years, has ben appointed by Governor J. M. Futrell of Arkansas.

The board, a non-political body, serving without pay for the purpose of developing a long-time plan of state benefit, is headed by former Gov. George W. Donaghey, chairman, and Roy W. Spence, secretary. It will be assisted in its work by a state planning engineer, to be appointed through the CWA by Harry L. Hopkins. Draftsmen and stenographers also will be furnished by the CWA.

Particular attention is to be paid in Arkansas to the development of recreational centers.

Wisconsin Engineers Hold Meeting At Madison

MEETING at Madison, Wis., Feb. 22 and 23 for its annual convention the Engineering Society of Wisconsin discussed platting; U. S. Coast and Geodetic Surveys; CWA; wood, concrete and aluminum as materials; Diesel engines, pumps and water purification at Milwaukee; highway safety and air conditioning for residences.

The society, as it has for many years, met in one session with the Technical Club of Madison to hear a general topic discussed. Dr. P. V. Faragher, chemical engineer of the Aluminum Company of America, traced the history of this metal from the discovery of a practical way of producing it, 50 years ago at Oberlin College, to its latest uses on the bridge floor of the overloaded Pittsburgh bridge (see *ENR*, Nov. 23, 1933, p. 611), the Union Pacific three-car train, just put into service, and construction equipment, such as draglines, shovels and trucks, all made possible by alloying and heat treating to increase the strength comparable with steel.

Surveying and platting

Platting provisions in Wisconsin law are in a rather chaotic state. Vernon Hamel, an engineer-lawyer heads a committee on revision and codification of the engineering, field and office requirements. It is the intention to continue this work utilizing the many suggestions and criticisms received on the floor plus such as come by correspondence and present them to the legislature next year. Opinion seemed against use of any reproduction copies for filing purposes. Originals on durable white paper or muslin in black ink were preferred because of permanency. Mr. Hamel favored no colored inks but dotted thin black lines for dimensions. Fixing corners of lots by long iron stakes rather than wood was advocated. Strenuous objection was made to the destruction of markers by highway operations without replacement or reference ties before removal.

Robert Campbell, Milwaukee, representing Local 54, Architects, Engineers and Technical Draftsmens Union spoke at length on the work in Milwaukee County in bringing map and plat records down to date in accordance with abstract records with 100 CWA workers. It will require a year to complete the work, he said. He felt maps and plats now concentrated in two places within eight blocks of each other should be kept also in the state land department at Madison to prevent possible loss by fire, tornado or other catastrophe.

George Randall, Oshkosh, described a loose-leaf system of filing plats prepared by the surveyors for the recorder of deeds so that the latter need only stamp for filing as received.

Prof. Ray S. Owen, state representative of the U. S. Coast and Geodetic Survey, has employed ten parties in making some 26 secondary loops in the state. Methods of measurement, having a 1 to 10,000 accuracy, were demonstrated by one of the parties. Transit measurement of angles turned 24 times was also shown. Two stations only per day are occupied normally.

Filtration for Milwaukee

Herbert C. Schmitt, research engineer, Milwaukee Department of Public Works, recorded the history of the fight for water filtration, the 1911 report of Alvord, Eddy & Whipple and eight subsequent reports all recommending filtration, finally culminating in a $4,600,000 bond issue and PWA financing all but completed at the present time. Detailed plans are now in course of preparation. The 200-m.g.d. plant with 32 filters and 30 m.g.d. clear well will soon be under way within a 38-acre cofferdam enclosure in the lake opposite the North Point pumping station. Organized opposition by large taxpayers carried the case unsuccessfully to the state Public Service Commission which has jurisdiction and issues permits of necessity in Wisconsin for city as well as privately owned water plants. The case was appealed to the circuit court but the Commission's original permit order was upheld.

In discussion L. F. Warrick, state sanitary engineer, called attention to the water borne amoebic dysentery outbreak in Chicago and the necessity of filtration to remove the cyst form. There is required at least 100 times as much sterilizing agent to kill the amoeba in the resting stage as it does to kill bacteria of the typhoid group.

Recent forest products research was outlined by George Trayer, Forest Products Laboratory. He demonstrated recently developed methods of making joint connections. Eight lookout towers of wood are being pre-fabricated with pin-connected joints and shipped knocked down, all treated after being sized. An arched, laminated roof was shown in model as was a section of plywood with floor and ceiling. The plywood was nailed and glued to planed 2x6 floor joists, reducing the thickness over ordinary construction some 4 in. New chemical treatments now materially reduce kiln-drying time.

PWA Promotes Ten-Year Plan of Pollution Abatement

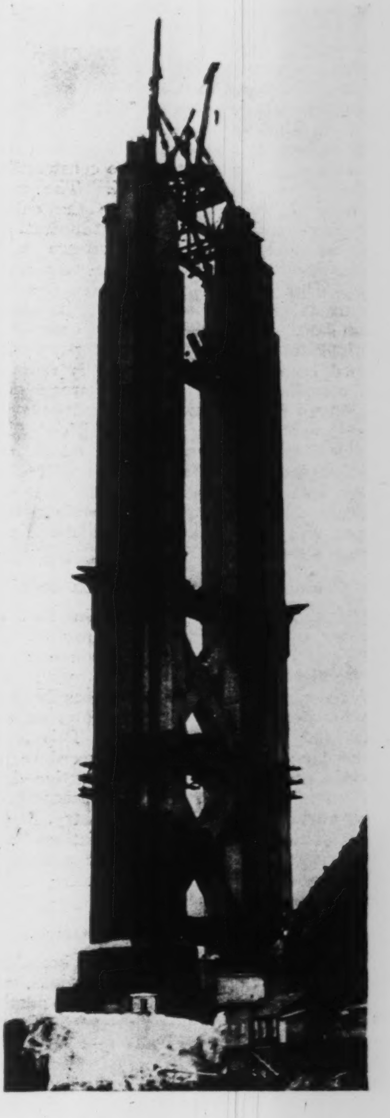
At a recent meeting in Hammond, Ind., called by C. M. Moderwell, PWA regional director of five middle west states, the Calumet and other Indiana cities were urged to plan a 10-year program, involving a progressive clean-up of stream and lake pollution. He cited the programs in Illinois and Wisconsin on the Fox and Rock rivers as an example of effective cooperation. There were present representatives of the Indiana PWA State Advisory Board, State Board of Health, city engineers and other officials and heads of industry. All expressed a willingness to proceed if financing in some way could be devised.

The Indiana legislature has suspended the operation of the sanitary district law until 1938 so that avoidance of the 2 per cent debt limit and 1½ per cent maximum tax levy is precluded by district formation. This leaves in Indiana only two methods of financing: by special assessment or by sewer revenue bonds. Bloomington, Ind., has had a successful financing of a disposal plant by the latter method, basing the collection on the water used. The water charge is increased by 10 to 12c. per 1,000 gal.

Washington Planning Council Named by Governor

Governor Clarence D. Martin, of Washington, has named the nine members of the Washington State Planning Council, and authorized that body to begin at once a survey of the state resources, drawing plans for future utilization, and paving the way for greater industrial expansion throughout the state. The measure creating the commission carried no appropriation, but the council has about $185,000 at its disposal, $80,000 allocated by the federal government and the remainder from the $10,000,000 state bond issue for unemployment relief. The council members are Nathan Eckstein and Miller Freeman of Seattle, Elmer L. Breckner, Tacoma; E. F. Banker, state director of conservation; Fred Nelsen of Renton Junction, A. E. Larson of Yakima, J. M. McClelland, Longview, and Eldridge Wheeler of Montesano.

MARIN TOWER of the Golden Gate Bridge in California. Steel work is here shown at the 500-ft. level. The total height will be 700 ft.



Organization Under Construction Codes Makes Progress

ADMINISTRATOR Hugh S. **Johnson** has announced the appointment of three non-voting members of the Construction Code Authority to represent NRA, the full number permitted under the construction code. They comprise a prominent labor leader, a New York City banker, and a machinery manufacturer, as follows: Michael J. McDonough, of Washington, D. C., president of the Building Trades Department of the American Federation of Labor; Jeremiah D. Maguire, of New York City, president of the Federation Bank and Trust Company; and George R. Dempster, of Knoxville, Tennessee, formerly a general contractor and road builder, city manager of Knoxville, Tennessee, and later commissioner of Finance and Taxation for the State of Tennessee.

The next meeting of the Construction Code Authority is slated for March 6, the date being set conveniently for the conferences of Code Authorities and Code Committees called by NRA to discuss important phases of industry codes.

The Construction Code Authority has requested its members to call the attention of firms in the industry to the fact that Chapter I—General Provisions, is binding on all members of the construction industry on March 2, 1934. The provisions of the code apply to the entire industry as defined "excluding operations therein undertaken in accordance with bona fide bids made not more than sixty (60) days prior to the effective date or contracts entered into prior to the effective date." Also, an employer complying with hours of labor or rates of pay established on government projects is relieved of compliance with hour and wage provisions of the construction code. Similarly, employers complying with provisions of a valid labor agreement in force on the effective date are relieved to the extent of their legal obligations thereunder of compliance during the period of such agreement with any conflicting provisions of the construction code.

Compliance with construction code

Pending the establishment in the industry of proper agencies expressly authorized by NRA to act in such matters, complaints as to compliance with the provisions of Chapter I necessarily will be handled by the State Directors of the National Emergency Council. This is in accordance with the usual procedure to bridge the gap between the effective date of an industry code and establishment of self-government within the industry. Members of the various trade associations have been urged to give all possible assistance to these State Directors to bring about compliance with the code.

Local administrative arrangements

Many communications have been received from local trade associations, requesting that they be authorized to administer the construction code within their respective territories. Those inquiring have been advised that the construction code places the responsibility for administration—national, regional and local—on the Divisional Code Authorities; administrative committees, agencies or representatives will be appointed by the respective Divisional Code Authorities to serve in the regions, states or localities from which these requests come; definite plans of coordination for local code administration are now being developed by the Construction Code Authority and the national trade associations sponsoring the code and the divisional chapters, to whom application should be made for further information. Each Divisional Code Authority will administer Chapter I and its specific divisional chapter, and hence complete industry administration within a division must await the establishment of the Divisional Code Authority after approval of the divisional chapter.

Registration of members

Rules and regulations issued by the Administrator under date of February 12 requiring the registration within thirty days of members of all industries by their code authorities and the posting of official copies as supplied by NRA of labor provisions of codes, have caused so much discussion and practical difficulties as to their operation that they are to be replaced by other regulations which will grant additional time for registration. It is expected that registration of members of the construction industry will be conducted by the several Divisional Code Authorities.

The registration of members of the industry is not to be confused with the registration of contracts provided for in the construction code, regulations for which are now being prepared by the Construction Code Authority.

Status of divisional chapters

Chapter III, Painting, Wallpapering and Decorating Division, having passed the muster of NRA Advisory Boards is about ready to be submitted for approval.

Conferences are under way with respect to several other divisional chapters. The latest draft of the electrical contracting chapter includes a minimum skilled labor rate of seventy-five cents per hour throughout the country which was agreed to a month or so ago by several thousand electrical contractors. Final determination of the inclusion of this skilled rate will have a bearing upon similar questions in other chapters of the construction code.

Contractors Code Authority

The Executive Committee of the Associated General Contractors will meet in Washington on March 3 to elect the members of the Divisional Code Authority for General Contractors, of whom twelve will be appointed from the Board of Governors or Advisory Board and the remaining five from non-members of the A. G. C. It is expected that this Divisional Code Authority—the first to be established under the construction code—will be organized on March 5.

The sub-chapters under the General Contractors Division covering, respectively, building contractors, heavy construction and railroad contractors, and highway contractors, are being rushed to completion in order that they may be submitted to the Administrator and approved to become effective on or as soon as possible after March 19, the effective date of Chapter II—General Contractors Division.

F. R. Dravo, Noted Contractor, Killed in Railroad Wreck

Francis R. Dravo, president of the Dravo Contracting Company, Pittsburgh, Pa., was among the nine persons killed in the derailment of a Pennsylvania Railroad train in Pittsburgh on Feb. 26. The train, approaching Pittsburgh from Akron, was derailed on a walled embankment on the North Side and the locomotive and some of the cars plunged over the wall into the street.

Mr. Dravo was one of the foremost contractors on heavy engineering work in the country, his firm having built a large number of dams and locks on the Allegheny, Monongahela, Mississippi, Ohio and other rivers, also numerous bridges and tunnels, including the International Bridge of the Grand Trunk Ry. over the Niagara River, and the Beaver Bridge for the Pittsburgh and Lake Erie R.R. The firm also did much work for the steel companies at Pittsburgh and has designed and built large cranes and like equipment.

Mr. Dravo was 68 years old, a native of Pittsburgh. He graduated from Lehigh University in 1887. Before graduation he worked for the Pittsburgh Locomotive Works, and in 1891 became a member of the firm of F. R. Dravo & Co., a firm that was succeeded in 1901 by the Dravo Contracting Co. At the time of this change Mr. Dravo was elected president of the Dravo Contracting Co. and has continued in that capacity since that date.

Contract Let for Post Office On Fourth Call for New Bids

Contract for the superstructure of the post office annex at New York has been let to James Stewart & Co., New York, on its bid of $4,287,700. The same company, more than a year ago, completed the substructure, a complicated framework carried down between the approach tracks to the Pennsylvania R.R. passenger station between 7th and 8th Ave. The annex is to be located back of the present post office and will fill out the block bounded by 8th and 9th Ave., 31st and 33rd St.

The present award is made on a fourth call for bids issued immediately following the rejection of the third set of bids on Jan. 30. In the new call no significant changes were made in the specifications for the building itself. The bids were as follows:

James Stewart & Co., New York	$4,287,700
Geo. F. Driscoll Co., Brooklyn	4,378,580
Kenny Bros., New York	4,393,000
Jos. Meltzer, Inc., New York	4,678,000
Chas. T. Wills, New York	4,836,500

On the previous bids the George F. Driscoll Co. submitted a low bid of $4,293,790 for the entire building and James Stewart & Co. submitted a low bid of $3,997,000 on the building with the fourth and fifth floors unfinished. On a still earlier bid the Driscoll Co. was low. For statements concerning the rejection of the earlier bids see *ENR,* Nov. 2, p. 540, Nov. 16, p. 607 and Nov. 30, p. 668.

Other contracts on the building let Feb. 26 were: elevators, the A. B. See Elevator Co., New York, $206,249; mail-handling equipment, Logan Co., Louisville, Ky., $413,750; lighting, Moe-Bridges Co., Milwaukee, Wis., $33,000.

Minnesota Engineers Meet with Architects At Annual Convention

A TWO-DAY MEETING of the Minnesota Surveyors' and Engineers' Society at Minneapolis Feb. 22 and 23 was followed by a continuation of another day of the program under the auspices of the Federation of Architectural and Engineering Societies. Discussions of codes, CWA, PWA and CCC, conservation of water resources, upper Mississippi development and concrete road design made up the program of the engineers and surveyors.

Housing, utility troubles, aviation developments, trends of manufacturing in the Northwest and the St. Lawrence waterway furnished the technical program for the Federation.

Approval of the St. Lawrence treaty in its present form was not forthcoming, at least two of the eleven constituent society representatives raising serious objection. Fear of competition from foreign manufactured goods under a lowered tariff as well as the advantages the East, with greatly reduced power costs, might offer to Minnesota manufacturers, caused those in attendance to table an approval and pass a resolution referring the matter to the separate societies for consideration and subsequent report.

Registration in Minnesota was greatly strengthened by last year's legislation, it was reported. July 1, 1933, was set as the dead line for engineers to register under the grandfathers' clause. More than 700 came in, bringing the total registrations to nearly 1,200.

A tentative code for the Minnesota group, containing elaborate provisions and restrictions and involving fees and fair practice procedure was adopted but left in the hands of the code committee to present to the local coordinator if, as and when appointed.

Drainage and flood control

On conservation, Walter S. Olson, director of drainage and waters, State Department of Conservation, described five storage and flood control projects for the west and northwest portion of the state where drought conditions have for several years all but dried up the water supply for towns on the Red River of the North and the Minnesota River. Flood control is also involved, as the topography in general is extremely flat. Financing was proposed through PWA but none of the prior projects got to Washington. All were based largely on farm land benefits. A state planning board of seventeen members to take up this and all other natural resource, economic and general welfare problems of the state was appointed by the governor on the same day Mr. Olson's address was given.

Frank T. Sheets, of the Portland Cement Association, explained simple rational formulas for use in designing concrete road slabs to fit various traffic expectancies on primary, lightly travelled primary and secondary roads.

Housing problems

In a paper on "Housing," by Prof. Robert T. Jones, University of Minnesota, there was presented a picture of Europe's 50 years of experience contrasted with the efforts at modern controlled multiple housing in this country. An organized and wisely directed community action must be continuously applied to combat successfully the tendency for areas to decay. "The spectre of obsolescence is forced into the background by the simple formula of making every occupant on a site a stockholder in the entire neighborhood community. Zoning avoids chaos but unless it is flexible and that flexibility is administered by the most intelligent planners decay follows on zoning." House builders then move to the outskirts to escape congestion, at substantial expense to the city for extended utility services. The solution, he felt, is continuous control before and after building. Following this view he would have city planners given power to initiate changes. The Federation went on record approving legislation granting this initiation.

Professor Jones favored state action rather than private initiation of housing projects and welcome the apparent activity of a federal agency that will contribute largely to local housing projects ultimately operated by local housing authorities on a non-commercial basis with 75 to 100 per cent grants of the original outlay. England, he said, has rehoused one-eighth of its population since the war. Liverpool in the last six month has appropriated $36,000,000 for slum clearance. Of the 500 housing projects in Washington only a very few have been or could be approved. Minnesota had a housing authority law in the last legislature which failed of passage. Another try will be made.

Present problems of the utilities were portrayed by William H. Hodges, vice-president, Byllesby Engineering and Management Corporation, particularly as to tax increases and the governmental competition. He deplored the "taxless-town" publicity of the municipal owner advocates and the statements as to the excess profits of the utilities.

Minnesota for some time has ben anxious about the trend of industry away from its

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

LOCALITY	LOAN AND GRANT OR GRANT	TYPE	AMOUNT
Sevierville, Tenn.	L. & G.	Waterworks and sewerage	$96,000
Oak Hill, Ohio	L. & G.	Waterworks	100,000
Commonwealth of Mass	L. & G.	Highway	101,000
Whittemore, Iowa	L. & G.	Sewer	3,000
Suffern, N. Y.	L. & G.	Sewage plant	265,000
Missouri Valley, Iowa	G.	Waterworks	5,600
Denton, Tex.	L. & G.	Building	220,000
Sedan Kan.	L. & G.	Waterworks	90,000
West LaFayette, Ind	L. & G.	Building	225,000
Glendale, Mo.	L. & G.	Sewer system	110,000
Hamilton Co., Ohio	L. & G.	Highway	97,000
Southampton, N. Y	L. & G.	School	125,000
Dawsonville, Ga.	L. & G.	School	13,965
Folcroft, Pa.	L. & G.	School	24,000
Copeland, Kan.	L. & G.	Waterworks	23,000
Cotton Plant, Ark	L. & G.	Waterworks	60,000
Van Wert, Ohio	L. & G.	Sewage plant	161,000
St. Mary, Mo	L. & G.	School	32,000
Kalamazoo, Mich.	L. & G.	Flood control	23,000
Corpus Christi, Tex	L. & G.	Schools	450,000
Kalamazoo, Mich.	L. & G.	Sewer	54,000
Elvins, Mo.	L. & G.	School	25,000
Gainesville, Ga.	L. & G.	Alms house	32,000
Rocky Mount, N. C	L. & G.	Waterworks	310,000
Calico Rock, Ark	L. & G.	Waterworks	40,000
Sycamore, Ill.	L. & G.	Water mains	10,000
Fairmont, Minn.	L. & G.	Sewage plant	63,000
New York Mills, Minn	L. & G.	Waterworks	34,000
Coffeyville, Kan.	G.	Swimming pool	7,700
Silverton, Col.	L. & G.	Waterworks	11,000
Sherburne Co., Minn	G.	Waterworks	2,500
Wheaton, Minn.	G.	Waterworks	5,700
Litchfield, Minn.	G.	Waterworks	2,600
Wabasha Co., Minn	G.	Road improvement	32,800
Dakota Co., Minn	G.	Road improvement	27,600
Scott Co., Minn	G.	Highway bridge	15,700
Rhinelander, Wis	L. & G.	School	45,000
Newman, Ill.	L. & G.	Waterworks	50,000
Washington Co., Miss	L. & G.	Roads	531,000
Turtle Creek, Pa	L. & G.	School	193,831
Mt. Ida, Ark	L. & G.	Waterworks	24,000
Austin, Tex.	L. & G.	Sewerage	500,000
McKean Co., Pa	L. & G.	Schools	618,000
North Vernon, Ind	L. & G.	Waterworks	25,000
Moss Point, Miss	L. & G.	School	55,000
Rockmart, Ga	L. & G.	Swimming pool	$8,000
Indianapolis, Ind.	L. & G.	Garbage disposal plant	62,000
New Canaan, Conn	L. & G.	Sewer system	88,000
Edinburg, Ind.	L. & G.	Electric power plant	82,000
Talladega, Ala.	L. & G.	Sewage plant	28,000
Quitman, Miss.	L. & G	Waterworks	30,000
Cedartown, Ga.	L. & G.	Building	7,000
Lawrence, Pa.	L. & G.	Viaduct	250,000
Freeport, Tex.	L. & G.	Wharf and warehouse	550,000
Perkasie, Pa	L. & G.	Boiler house	55,000
Harper, Kan.	L. & G.	School	53,300
Coventry, R. I	L. & G.	School	100,000
Crookston, Minn.	L. & G.	Street improvements	10,100
St. Joseph, La.	L. & G.	Courthouse	14,000
Canton, Conn.	L. & G.	School	100,000
Gloucester, R. I	L. & G.	School	100,000
Ponca City, Okla	L. & G.	Waterworks	560,000
Methuen, Mass.	L. & G.	Sewer system	103,000
Kendal, Wis.	L. & G.	Sewage treatment plant	12,000
Kalamazoo, Mich.	L. & G.	Sewer	64,000
Kalamazoo, Mich.	L. & G.	Sewage treatment plant	415,000
Sunflower Co., Miss	L. & G.	Schools	30,000
Ponca City, Okla	L. & G.	Library	100,000
San Antonio, Tex	G.	Building	4,500
Walton Co., Ga	L. & G.	Jail	61,000
Cleburne, Tex.	L. & G.	Waterworks	35,000
Goshen, Ind.	L. & G.	Sewers	455,000
Rowlesburg, W. Va	L. & G.	Waterworks	16,000
State of Kansas	G.	Dormitory	55,000
State of Indiana	G.	Bridge	24,800
Larned, Kan.	G.	Building	6,000
State of Indiana	G.	Highway	11,600
Warsaw, Ky.	L. & G.	Waterworks	32,000
Poplarville, Miss.	L. & G.	School	20,000
Guthrie, Ky.	L. & G.	Waterworks	77,000
Winston-Salem, N. C	L. & G.	Channel improvement	90,000
Lawrenceburg, Ind.	L. & G	Sewage plant	59,000
Jefferson City, Mo	G.	Remodeling building	6,500
Lowell, N. C	L. & G.	Waterworks	47,000
Chickasha, Okla.	L. & G.	Courthouse	189,000
Ashland, Ky.	L. & G.	Sewer system	47,000
Carthage, Mo.	L. & G.	Viaduct	30,000
State of Connecticut	G.	Roads	124,000
Itasca Co., Minn	G.	Repair of bridges	9,000
Trumbull, Conn.	G.	Underpass	120,000
State of Connecticut	G.	Roads	15,000
		Total	$9,295,796

boundaries and the decrease in industrial wage earners in all but the metropolitan areas of the Twin Cities. Prof. F. B. Garver, University of Minnesota, presented many charts showing such trends for the whole country as well as Minnesota, but the evidence is so contradictory he refused to assign reasons. A. C. Godward, executive engineer, Minneapolis Industrial Committee, in discussion, blamed politics for much of the industry loss.

Newly elected officers of the Surveyors' and Engineers' Society are as follows: President, L. P. Zimmerman; vice-president, C. M. Robertson; and secretary-treasurer, Harold Chard. For the Federation, J. L. Strong, Duluth, was elected president, to succeed W. N. Carey; and Albert Buenger, treasurer. Katherine A. Feucht continues as secretary.

Ohio Planning Board Begins Activities

Ohio's new Planning Board, headed by Dean Walter J. Shepard, of Ohio State University, has begun work on the preparation of a three-point preliminary program. The plan includes the preparation of a program of public works to be completed during the next 10 years, the perfection of a state-wide transportation system and the classification of the state into areas for recommended land uses.

The state board will in collaboration with the National Planning Board advise with the Ohio Public Works Administration in the selection of public works projects.

Chevalier Heads New Group of McGraw-Hill Publications

Willard Chevalier, for eight years publishing director of *Engineering News-Record* and *Construction Methods*, published by the McGraw-Hill Publishing Co., has been elected vice-president of the company and placed in publishing charge of a group of publications comprising in addition to the two just named *Construction Daily*, *Engineering & Mining Journal*, *Metal & Mineral Markets*, and *Coal Age*.

Col. Chevalier has been with the McGraw-Hill Publishing Co. since early in 1922, when he joined the editorial staff of *Engineering News-Record*. A year later he was appointed business manager of the paper, and in December, 1927, became publishing director of the civil engineering and construction papers of the company.

Col. Chevalier is a graduate in civil engineering of Brooklyn Polytechnic Institute, in the class of 1910. Previously he had been with the construction department of Arbuckle Bros., Brooklyn, from 1903 to 1905, and with the Consolidated Telegraph and Electrical Subway Co., New York, from 1905 to 1910. From 1910 to 1912 he was with the Public Service Commission on the design of subways in New York City, and from 1912 to 1916 he was, first, field office manager of the Atlantic Gulf & Pacific Co. on construction of the Champlain section of the New York State Barge Canal, and, later, on harbor development work at New York. From 1916 to 1921, except for the war period, he was associated with the American Bitumastic Enamels Co., New York, (now Wailes-Dove Hermiston Corp.) as sales manager and later general manager. During the war he served with the 11th Engineers in France, as captain, major and lieut. colonel.

Five Bids Received on Tunnel Under Hudson at New York

Five bids were received by the Port of New York Authority on Feb. 21 when bids were opened on the construction of the under-river portion of the south tube of the proposed midtown Hudson tunnel. The bids were as follows: Mason & Hanger Co. Inc., $6,452,300; George H. Flinn Corp., $7,393,214; the Carleton Co. Inc., $7,414,753; Thompson-Starrett Engineering Associates, Inc., $7,490,333; and Rosoff-Brader Construction Corp., $8,783,830.

The midtown Hudson tunnel is planned to consist eventually of two tubes about on the line of West 39th St., New York, extending under the Hudson River to Weehawken, N. J. The work now being undertaken calls for driving only the south tube and the construction of part of the necessary plazas, connecting streets and highway connections at the New York and New Jersey ends. The south tube will be used for vehicle traffic in both directions until the north tube is built.

The work covered by the bids received on Feb. 21 relates to the construction of the under-river portion of the south tube, about 6,000 ft., between the New Jersey ventilation shaft, located about 1,000 ft. west of the bulkhead line, and the New York construction shaft on the south side of 39th St. between 11th and 12th Aves.; construction of about 60 ft. of rock tunnel west of the New Jersey ventilation shaft, and construction of a ventilation shaft on each side of the river. The cast iron and cast steel lining and bolts are not included, contract for that work having been let some months ago. The New Jersey ventilation shaft, which will form the foundations of the basement, sub-basement and lower portion of the air ducts of the ventilation building, will be of steel and reinforced concrete in an excavation in rock. The New York River shaft, which forms the foundation of the New York ventilation building, is to be constructed by means of a steel and concrete pneumatic caisson. The superstructure of the two buildings is not part of the contract.

The contractor will be required to provide, in addition to the ventilation shafts, temporary shafts on both sides of the river which will be used by him as construction shafts.

The greater part of the tunnel will be constructed by the shield method under compressed air. The contractor will be required to carry on the tunneling operations in both directions simultaneously.

Work on the contract is to be completed on or before March 1, 1937. It will be carried to the point where the new tube is ready for interior finish, paving, electrical and mechanical installations.

A loan of $37,500,000 to the Port Authority has been approved by the PWA and the work is being carried out under PWA requirements, including the 30-hour week for those employed directly on the project. The wage rates to be paid by the contractor are set forth in detail in the call for bids.

The tube is to be 31 ft. in outside diameter, slightly larger than the tubes of the Holland tunnel.

The Port Authority on Feb. 28, received bids on land borings for the New York approach.

Additional details of the project well be given in a subsequent issue of *Engineering News-Record.*

SOCIETY CALENDAR

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill., March 13-14, 1934.

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, N. J., June 25-29, 1934.

AMERICAN WATER WORKS ASSOCIATION, annual convention, New York, June 4-8, 1934.

SMOKE PREVENTION ASSOCIATION, annual convention, June 19-22, Buffalo, N. Y.

IOWA ENGINEERING SOCIETY will hold its annual meeting March 6, 7 and 8 at Ames. The meeting has been postponed from Feb. 13 on account of the critical situation in which engineers found themselves due to the closing up of CWA and CCC work and the starting of new projects. Some of the scheduled subjects are phases of CWA, PWA and CCC; highway program, finances, road surface characteristics, shear in slabs and correlation of highways with railroads; taxation systems; special assessments and heavy rainfalls. John S. Dodds, Ames, is secretary-treasurer.

FLORIDA SECTION, American Water Works Association, will hold its eighth annual meeting at Daytona Beach, Fla., April 16-17.

INDIANA ENGINEERING SOCIETY at its annual meeting in Indianapolis on Feb. 17 elected as president William C. Mabee, chief engineer of the Indianapolis Water Co.

DULUTH ENGINEERS CLUB has elected E. W. R. Butcher president. Mr. Butcher is chief engineer of the Republic Steel Co.

ENGINEERS CLUB of Northern Minnesota has elected president M. L. Bradt, of Hibbing.

Personals

Paul W. Richards has been appointed assistant superintendent of the garbage disposal plant at Indianapolis, Ind.

Cletus C. Kessler, of Lockwood, Kessler and Bartlett of New York City, has been appointed city engineer for Long Beach, L. I.

Thomas Acton Fitzgerald has been appointed street commissioner of Boston, Mass., succeeding John J. O'Callaghan, who retired on January 31.

D. H. Walsch, Longview, Wash., has been named engineer and supervisor for the Consolidated Diking District No. 1 including Longview and West Kelso.

Elroy S. J. Irvine, Major, Corps of Engineers, U. S. Army, has been nominated by President Roosevelt as a member of the California Debris Commission.

Dennis F. Mulvihill, civil engineer, has been appointed temporary manager of the Detroit city airport during the absence of Perry A. Fellows who has been granted a six months leave of absence to accept a position with the Civil Works Administration.

Jesse B. Snow, division engineer, Board of Transportation, New York City, who was named acting chief engineer of the board upon the retirement of Robert Ridgway, has been made chief engineer of the Board. Mr. Snow is a graduate of Union College of the Class of '89. He was engaged in railroad and municipal work and was in private practice until in 1905 when he began work on the Pennsylvania Railroad Terminal at New York as inspector. For the following five years he was engaged on that work, becoming first assistant to the resident engineer in 1906, in general charge of construction and alignment of the two southerly tunnels under the East River at New York. From 1910 to 1914 he was again in private practice, and from

1914 to 1919 was resident engineer for the Public Service Commission of New York on construction of the East River Tunnels. Subsequently he was principal assistant engineer on the Holland Tunnel, was appointed Tunnel engineer of the projected Staten Island Tunnel and, for the Board of Transportation, was in charge of the three East River Tunnels of the Independent Subway System. William McKenna Griffin, assistant division engineer, Board of Transportation, has been appointed division engineer to succeed Mr. Snow.

Obituary

H. A. McLean, former city engineer at Prince Rupert, B. C., who retired several years ago, died at his home on February 15 following a lengthy illness.

Michael Doll, retired contractor of Utica, N. Y., died in that city on February 19, aged 78 years. He built many important buildings in the Mohawk Valley section.

Ewing Shields, 71 years old, for years a prominent contractor of Indiana and president of Ewing Shields & Son, died recently at his home in Indianapolis.

James M. Hodge, a retired civil engineer, died at his home in Plymouth, Mass., February 24 at the age of 84. He was a native of Plymouth and was graduated from the Massachusetts Institute of Technology in 1879. He retired from practice in 1914.

Donald B. Cameron, for many years a contractor at Boston, Mass., died in Cambridge on February 19 after a 3-days' illness. He was born in New Glasgow, N. S., 57 years ago and for 25 years made his business headquarters at Roxbury, Mass.

J. A. Bernier, city manager of Grand-'Mere, Quebec, died recently at the age of 48. Mr. Bernier was a civil engineering graduate of the University of Montreal. Prior to assuming the position of city manager of Grand'Mere in 1925, he was for some years city engineer of Shawinigan Falls.

Andrew J. Foster, construction engineer for the Cities Service Co., died in Adrian, Mich., on February 22. He was 60 years old. Mr. Foster's office was in New York City and at the time of his death he was on company business in Adrian. He was born in Edwardsburg, Mich., and was graduated from Kansas State University with a degree in civil engineering.

Walter Camp Parmley, sanitary engineer, died on February 19 at his home in Upper Montclair, N. J. He was 72 years old. Mr. Parmley was graduated from the University of Wisconsin in 1887. For a time he was city engineer of Ogden, Utah and from 1896 to 1903 was sanitary engineer for Cleveland. He was the inventor of several types of reinforced concrete design.

Frank Lyon Wheaton, 72 years of age, retired civil engineer for the Delaware, Lackawanna and Western Railroad, died February 22, at Buffalo, N. Y. He was born in Camillus, N. Y., and graduated from Dartmouth in 1884. During the 30 years he was with the railroad, he worked on the erection of the Tunkhannock viaduct between Binghamton and Scranton, Pa., the extension of the railroad through the Delaware Water Gap and the construction of a tunnel in Newark, N. J.

CONSTRUCTION STATISTICS OF THE WEEK

Public contract awards increased this week to $19,637,000, making the total engineering contract awards for the week $24,231,000, since private awards held steady at $4,594,000. This week's total compares with $17,433,000 last week, the previous 4-weeks' average of $19,815,000, the average week to date of $22,786,000 and the weekly average for March, 1933, of $11,587,000. Federal awards are up from $2,956,000 last week to $6,370,000 and state and municipal awards rose from $10,267,000 last week to $13,267,000 this week. Private work contract awards show little changes totalling $4,594,000 this week and $4,362,000 last week.

Highway awards are up to $7.4 millions from $6.9 millions last week, water works contracts are double last week's, $1.2 millions compared with $0.6 millions; bridges at $2.7 millions compared with $0.7 millions last week, and public buildings jumped from $1.4 millions to $6.7 millions. In the private work industrial buildings increased from $0.5 millions to $2.8 millions and commercial buildings dropped back from $3.7 millions to $1.6 millions.

Large contracts include the grain elevator for Pacific Continental Grain Co. in Washington, $2,000,000; 200 dwellings at Cranford, N. J., $1,000,000; and the post office annex in New York City, $4,288,000 among the buildings; highway lettings of $539,000 by Ohio and $758,000 by Texas, and bridges, $828,000 in Ohio.

New capital also is up for the week. Both municipal bond sales and PWA allotments are higher. The municipal bond market continues very strong. This week's total sales for construction purposes total $9,560,000, the second highest week for the year, but the largest number of communities obtaining new productive financing. PWA allotments to municipalities increased from $200,000 last week to $9,296,000 this week. The improvement in the bond market is enabling cities to obtain loans through private investment sources. This has resulted, in Massachusetts and Connecticut alone, in changes in allotments from $12,335,420 for loans and grants to $3,454,500 for grants only, thus freeing $8,880,920 for additional allotments to other municipalities.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Mar. 1933	Weekly Average Prev. 4 Weeks	Week Mar. 1934
Federal Government	$2,538	$3,841	$6.370
State and municipal	4,373	12,311	13,267
Total public	$6.912	$16,152	$19.637
Total private	4,675	3,663	4,594
Week's total . ..	$11,587	$19,815	$24,231

Cumulative to date:
1933......$166,497 1934......$205,073

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

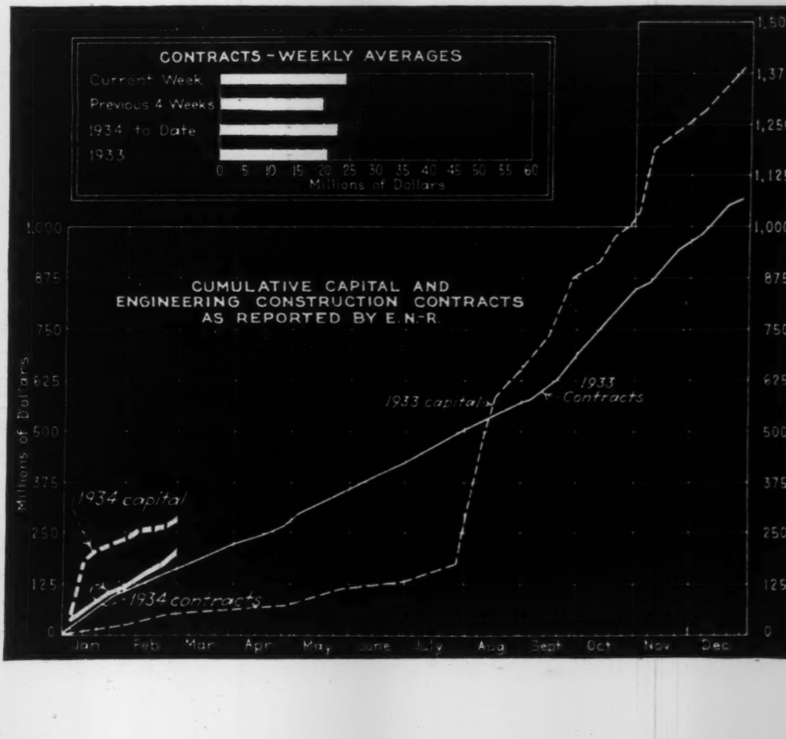
1934	Week Mar. 1	Cumulative
State and municipal.....	$9,560	$48,503
PWA allotments, S&M..	9,296	185,457
Corporate issues	....	10,418
PWA allotments, private	1,331	42,119
Total, Non-Federal....	$20,187	$286,497
PWA allotments Federal Constr.	1,462	47,251
Total new capital	$21,649	$333,748

Cumulative to date:
1933......$61,300 1934......$286,497
Rescinded or reduced allotments (from 1933 PWA totals)...... $43,323

INDEX NUMBER

E.N.-R.-Cost		E.N.-R.-Volume	
March, 1934....	**194.04**	**February, 1934**..	**88**
February, 1934...	194.04	January, 1934....	113
March, 1933.....	158.44	February, 1933...	82
1933 (Average)...	170 18	1933 (Average)...	102
1932 (Average)...	156.97	1932 (Average)...	127
1931 (Average)...	181.35	1931 (Average)...	220

1913 (Average)............100



Business Side of Construction

Contracts Gain Over Last Year; Cost Index Stationary

ENGINEERING CONSTRUCTION awards in February (not including CWA activity) exceeded February a year ago by 31 per cent in dollar value and by 6 points or 7 per cent on the volume index. The total for the four weeks is $79,261,000, a weekly average of $19,814,000. This is below the January weekly average of $25,395,000, due to a drop in public awards, principally federal and streets and roads. Public work was 81.5 per cent of the total in February or $64,608,000, with private work $14,653,000. Private work was practically the same as in January.

Highway lettings averaged $6,271,000 per week for the month, about two-thirds of the January average. Federal awards dropped to $15,365,000 or $3,841,000 per week, less than half the January total, while state and municipal awards at $49,243,000 are only 11 per cent under January. Both public and industrial buildings are down slightly, with commercial buildings up, aided by the award of a large housing contract.

Territorially the Far West is ahead of January this year and February of last year. Other territories are all down in the same proportion compared with January but West of Mississippi, New England and Middle West show substantial gains and South a very slight gain over February a year ago. The Pacific Coast Far West tops the territories this month at $19,324,000 with West of Mississippi running a close second at $18,249,000. Middle Atlantic at $15,609,000, Midwest at $11,667,000, and South at $10,071,000 all passed the $10,000,000 mark.

New Capital

February financing was characterized by a shift in emphasis from federal to "normal" methods of financing. PWA allotments dropped in February to $9,978,000 compared with $206,971,000 in January. Of the February total $5,214,000 was for loans and grants to states and municipalities and $4,764,000 for loans to corporations both railroads and limited dividend or non-profit corporations. The Public Works Administration announced that no more applications for loans would be received and that efforts would be concentrated on completing bond contracts for work now allotted or under application.

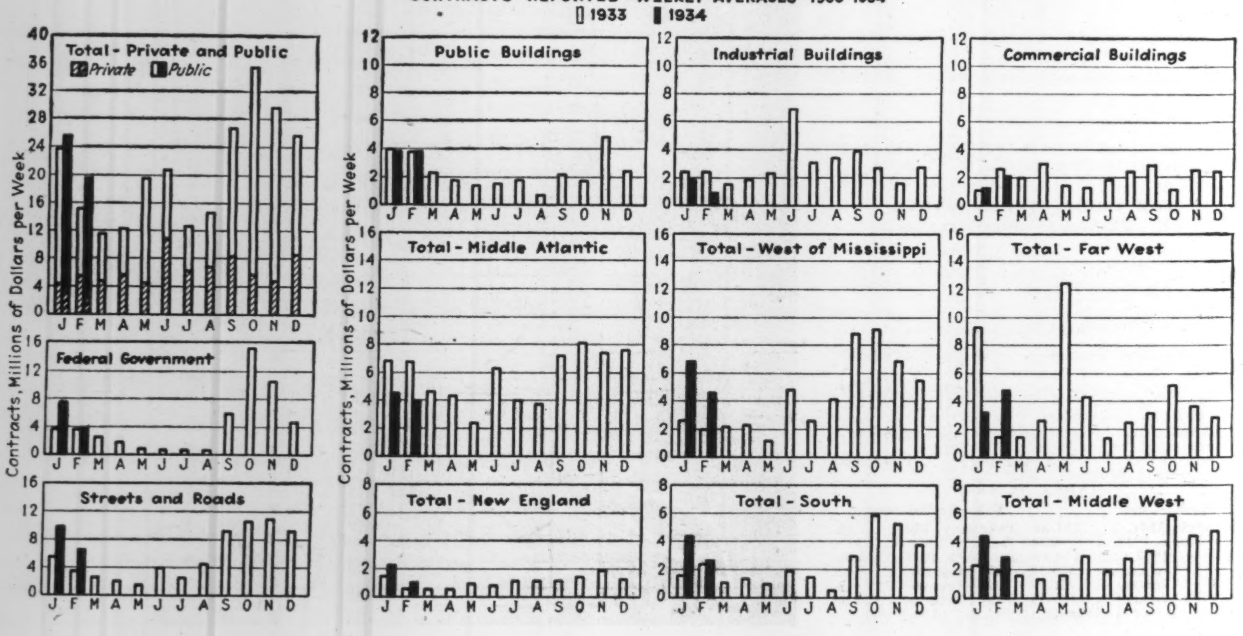
In the municipal bond market the strong recovery noted in January took effect in increased bond sales for productive capital in February. Municipal bond sales increased to $24,624,000 from $14,319,000 in January. This improvement in the bond market is felt in still another direction. The Public Works Administration reports "twenty-five of the applications

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN FEBRUARY, 1934

Four Weeks—Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States			Canada
							Feb. 1933	Two Months 1934	Two Months 1933	Feb. 1934
Public Works										
Waterworks	549	264	438	184	524	4,898	6,857	8,626	21,707	65
Sewers	761	4	211	2,176	.....	6	3,158	5,621	2,885	....
Bridges, public	16	2,135	1,015	205	3,735	930	8,036	16,866	7,005	....
Earthwork and waterways	21	29	146	896	4,171	1,984	7,247	24,738	16,382	....
Streets and Roads	707	5,314	5,026	3,821	6,544	3,673	25,085	64,696	35,822	....
Buildings, public	852	4,964	1,729	1,047	2,076	1,262	11,930	26,773	31,166	300
Unclassified, public	338	419	1,008	23	262	245	2,295	4,701	1,260	....
Total public	3,244	13,129	9,573	8,352	17,312	12,998	64,608	152,021	116,227	365
Federal gov't (included in other classifications)	742	2,158	961	1,770	6,446	3,288	15,365	45,492	29,495	....
Private										
Bridges, private	.....	41	.....	870	.....	.....	911	1,493	1,442	....
Buildings, industrial	968	680	481	618	147	409	3,303	10,661	18,839	196
Buildings, commercial	.....	616	.....	1,612	210	4,105	6,543	11,526	14,868	....
Unclassified, private	129	1,143	17	215	580	1,812	3,896	5,141	4,529	40
Total private	1,097	2,480	498	3,315	937	6,326	14,653	28,821	39,678	236
February, 1934 (4 weeks)	**4,341**	**15,609**	**10,071**	**11,667**	**18,249**	**19,324**	**79,261**	.....	.....	**601**
January, 1934 (4 weeks)	8,607	18,182	17,793	17,562	27,055	12,382	101,581	.....	.....	1,156
February, 1933 (4 weeks)	2,437	26,824	9,526	7,780	7,937	6,009	60,513	.....	.....	412
Two months, 1934	12,948	33,791	27,864	29,229	45,304	31,706	.....	180,842	.....	1,757
Two months, 1933	8 543	54,177	15 869	16.420	18,390	42.506	....	.....	155,905	1,214

CONTRACTS REPORTED—WEEKLY AVERAGES—1933-1934



for changes in allotments were requests for changes from loans and grants to grants only, the reason given by most of the applicants being that they have been or will be able to sell their bonds in the private investment market."

The municipal bond market continues strong and both the number of issues and dollar volume of sales for productive use of capital are increasing.

Corporate stock issues in February were swelled by the Mathieson Alkali financing for the new plant in Louisiana, $7,000,000. The total corporate issues in February, including this construction fund, was $7,513,000 compared with $2,905,000 in January.

Materials Notes

Cement—Portland cement production in January, 1934, was 3,779,000 bbl., compared with 2,958,000 bbl. in 1933. Shipments of 3,778,000 bbls. compare with 2,505,000 in the same month last year and stocks of 19,541,000 compare with 20,624,000 bbl. in 1933. In ratio of production to capacity, January, 1934, was 16.6 per cent compared with 12.9 per cent in January, 1933.

Bids received February 9, on 1,600,000 bbl. of cement by State Department of Public Works and Buildings, Springfield, Ill., averaged $1.84 per bbl. for Portland and $2.49 per bbl. for high early strength cement. Eleven companies submitted bids based on shipments to various points in the state.

Steel—Operating rate of steel companies having 98.1 per cent of the steel capacity of the industry was 43.6 per cent of the capacity for the week beginning February 19, compared with 39.9 per cent one week ago and 32.5 per cent one month ago. This represents an increase of 9.3 per cent over last week as reported by American Institute of Steel Construction, Inc. January bookings of steel construction, although fourteen per cent less than the bookings of December, were only about four per cent less than the amount of business booked January a year ago. The shipments this month represented a decline of approximately nineteen per cent from the previous month and twelve per cent from the record of the same month a year ago. These figures are compiled from the returns received from firms which represent approximately 85 per cent of the industry.

Reinforcing Steel—Minimum filed prices under the code are: For billet steel bars, $1.90 per cwt. at Pittsburgh, $1.95 at Buffalo, Chicago, Gary, Ind., Cleveland, Birmingham and Youngstown; $2.30 at Gulf ports except Mobile and New Orleans, $2.45 at Los Angeles and $2.05 at Detroit; for rail steel bars, $1.75 at Pittsburgh, $1.80 at Buffalo, Chicago, Gary, Birmingham and Youngstown, $2.15 at Gulf ports, $2.30 at Pacific ports.

Lumber—Lumber production and shipments during the week ended February 10, 1934 were the highest of any week of the year but new business at the mills was lower by about 12 per cent than the average of the preceding three weeks, according to the National Lumber Manufacturers Association based on reports from regional associations covering the operations of leading hardwood and softwood mills.

The Lumber Code Authority, Feb. 9 adopted what is virtually the primary reforestation law for all commercial timber lands subject to the code governing the lumber and timber products industries.

Future marking of lumber and timber products to indicate plainly the grade, size, species, source of manufacture and whether seasoned or unseasoned was provided by action of the Lumber Code Authority Feb. 12, which voted to submit to the Administration provisions governing this undertaking on the part of the industry as a whole. Upon the approval of President Roosevelt these new regulations will become mandatory in so far as lumber manufactured after that date is concerned. "This action," declared C. C. Sheppard, president, National Lumber Manufacturers Assn., "means that the element of chance is to be removed from the purchase of lumber by either the small or the large buyer, for every piece will be marked as to grade and size and species as adequately and accurately and authoritatively as a ten-dollar bill is distinguished from a five."

Labor

Labor rates in February showed little change. The common labor average for 20 cities remains unchanged and the skilled average is increased from 1.062 to 1.0687. This increase comes from Philadelphia which reports increased rates as follows: from $1.00 to $1.20 per hour top for bricklayers, from 50c. to 60c. minimum and from 75c. to $1.20 top for carpenters, from $1.15 to $1.20 top for structural iron workers and for plasterers a drop in minimum from 75c. to 60c. and an increase in top from $1.00 to $1.20.

Employment in the production of six major construction materials reported by Federal Employment Stabilization Board was 39.8 for January compared with 41.8 in December and 33.2 in January, 1933 (1923-1925 = 100).

Industrial fatalities reported by New York State Department of Labor for January included 13 deaths on construction work, which is one-third of the 5-year January average of 39.

Constitutionality of the Roberts act, under which the State Highway Department stipulates in its contracts for highway improvements the minimum hourly wage to be paid skilled and unskilled workers, varying according to locality, is now before the Ohio Supreme Court. The court admitted for review a Madison county case raising the question of the constitutionality of the act. Frank Zane, employed by L. L. Clymer, who obtained from the state a contract to build a portion of the National road between West Jefferson and Summerford, obtained a judgment in Madison county for the difference between 25 cents an hour he was paid and the 35 cents an hour minimum wage provided for in the contract.

ENR Cost and Volume Index

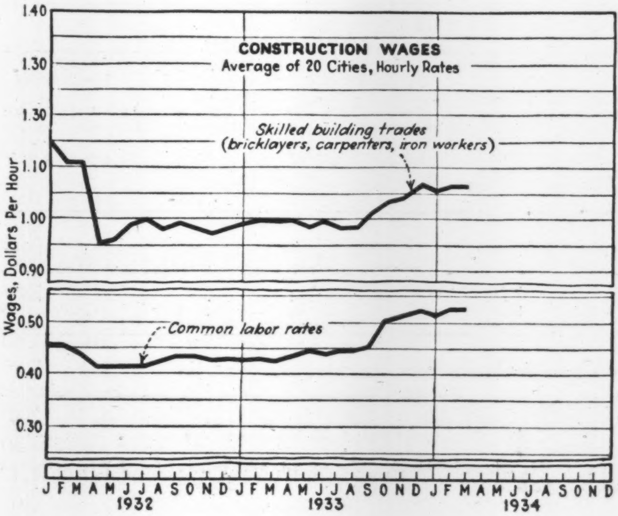
The *Engineering News-Record* Construction Cost Index for March is unchanged from February, 194.06. This is 22.5 per cent higher than a year ago.

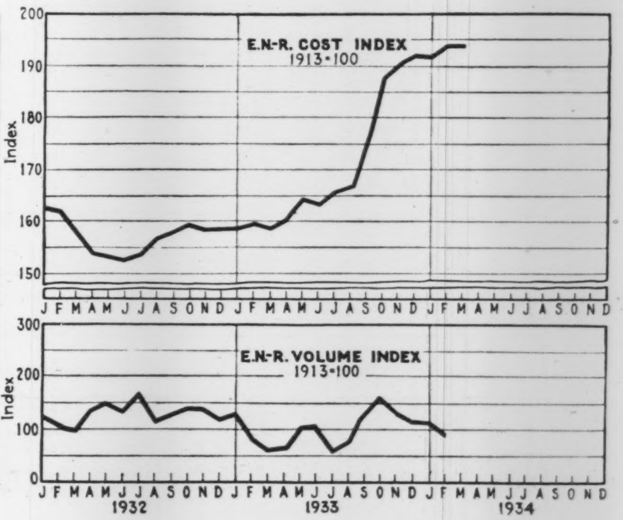
The *Engineering News-Record* Construction Volume Index for February is 88, lower than last month by 22 per cent but higher than last year by 7 per cent. Dollar value of February contracts is 31 per cent ahead of a year ago. None of these figures includes CWA work.

INDEX NUMBER

E.N.-R.-Cost		**E.N.-R.-Volume**	
March, 1934....	**194.04**	**February, 1934.**	**88**
February, 1934...	194.04	January, 1934...	113
March, 1933.....	158.44	February, 1933..	82
1933 (Average)...	170.18	1933 (Average) ..	102
1932 (Average)...	156.97	1932 (Average) ..	127
1931 (Average)...	181.35	1931 (Average) ..	220

1913 (Average)..............100





CURRENT PRICES OF CONSTRUCTION MATERIALS

CEMENT, AGGREGATES AND READY-MIXED CONCRETE

	PORTLAND CEMENT Per bbl., carload lots, f.o.b. city, including cost of bags			SAND AND GRAVEL Per ton, carload lots, f.o.b. city			CRUSHED STONE Per ton, carload lots, f.o.b. city		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE Ready Mixed 1:2:4, 50c.y. or more, delivered
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.92	$2.67	$2.67	$1.90	$1.90	$1.45	$1.60	$1.60	$1.60	$1.60	$8.00
Baltimore	2.71	2.46	2.26	1.80‡	2.00‡	1.25‡	1.90‡	2.00‡	2.25	2.25	7.75
Birmingham	2.55	2.30	2.05	1.75	1.75	1.40	.....	.....	.90	1.15	5.20
Boston	2.72	2.47	2.27	1.50	1.50	1.10	1.50	1.50	.....	.....	6.50
Chicago	2.85‡	2.60‡	2.00	2.50†	2.50†	2.25†	2.50†	2.50†	.....	.....	.....
Cincinnati	2.52	2.27	2.07	1.30	1.30	1.20	1.80	1.80	.....	.....	6.70
Cleveland	2.50	2.25	.....	1.50	1.50	1.45	1.55	1.55	1.75	1.75	7.85
Dallas	2.50	2.25	2.05	1.90	1.90	1.75	1.80	1.90	.....	.....	6.25
Denver	3.60‡	3.40‡	.....	1.85	.....	1.25	.....	.....	.....	.....	.....
Detroit	2.25	2.00	1.80	1.15	1.05	.85	.85	.85	.90	.90	5.75
Kansas City	3.14	2.80	2.25	.65	.65	.65	2.00‡	2.00‡	.....	.....	7.50
Los Angeles	2.90	2.65	.....	1.90	1.90	1.40	1.90	1.90	.....	.....	6.70
Minneapolis	2.75	.....	2.30	1.00	1.00	.25	1.00	1.00	.....	.....	7.00
Montreal	.....	1.70	.....	.....	1.50	1.35	.....	1.25	.....	.....	.....
New Orleans	2.52	2.27	.....	1.70	1.70	1.40	.....	.....	.....	.....	7.75
New York	2.90‡	2.65‡	.....	1.50†ᵏ	1.50†ᵏ	1.00†ᵏ	1.75†ᵏ	1.85†ᵏ	.....	.....	8.00
Philadelphia	2.55	2.30	.....	2.00‡	2.25‡	1.80‡	1.75‡	2.00‡	1.75‡	1.75‡	6.84
Pittsburgh	2.50	2.25	1.65	1.50‡	1.50‡	1.70‡	2.25‡	2.25‡	1.25	1.25	8.25
St. Louis	2.47	2.22	.....	1.75‡	1.75‡	1.65‡	1.75‡	1.75‡	.75§	.75§	7.20
San Francisco	2.37	2.17	1.87	1.75	1.75	1.75	1.65	1.65	.....	.....	7.00
Seattle	2.95	2.65	.....	1.50†	1.50†	1.50†	.....	.....	.....	.....	5.75

*Includes 40c. per bbl. for bags, 10c. allowed for each returnable bag. †Per cu. yd. ‡Delivered. §F.o.b. Granite City, Ill. ᵏBarge lots alongside dock.

CURRENT MILL PRICES CEMENT TO DEALERS, CARLOAD LOTS, F.O.B. MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Alpena, Mich	$1.65	$1.60	Ironton, Ohio	$1.60	$1.55	North Birmingham, Ala	$1.75	$1.70
Buffington, Ind	1.60	1.55	Iola, Kans	1.70	1.65	Richard City, Tenn	1.85	1.80
Crestmore, Calif	1.72	....	La Salle, Ill	1.60	1.55	Saginaw, Mich	1.65	1.60
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.60	1.55	Steelton, Minn	1.80	1.75
Hannibal, Mo	1.60	1.55	Mason City, Ia	1.70	1.65	Universal, Pa	1.65	1.60
Hudson, N. Y	1.75	1.70	Norfolk, Va	1.76	1.71	Waco, Tex. (Inc. 5c. Tax)	1.80	1.75
Independence, Kans	1.70	1.65	Northampton, Pa	1.65	1.60	Wyandotte, Mich	1.60	1.55

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME

	STRUCTURAL CLAY TILE — PARTITION Per M, lots of 2,000 pieces or over, delivered			STRUCTURAL CLAY TILE — LOAD BEARING Per M, lots of 2,000 pieces or over, delivered			BRICK Per M, in quantity, delivered		LIME Per ton, in paper, carload lots, delivered		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Hydrated finishing	Common hydrated	Pulverized or lump
Atlanta	$79.00	$84.20	$157.90	$189.50	$243.20	$277.90	$13.50	$13.50	$19.00	$13.00	$13.00
Baltimore	75.00	77.00	145.00	165.00	200.00	240.00	14.00	17.00	16.00	14.00	18.00
Birmingham	84.25	90.00	156.00	180.00	215.00	242.00	15.00	22.50	3.00§	1.75§	2.25§
Boston	99.00	105.00	197.00	209.90	258.40	295.00	14.00	16.00	19.00	15.00	21.00
Chicago	62.25	66.40	91.30	......	......	......	9.20	10.20	18.00	18.00	16.00
Cincinnati	44.25	53.80	98.00	113.20	149.10	169.40	11.00	13.50	15.20	11.20	.....
Cleveland	45.00	48.00	90.00	117.00	136.50	156.00	16.00	16.00	18.00	16.00	2.60§
Dallas	82.75	90.00	163.50	196.00	195.75	233.00	.....	15.50	16.50	16.50	2.50§
Denver	75.00	80.00	135.00	135.00	185.00	220.00	11.75	25.50	18.00	16.00	2.60§
Detroit	60.00	64.00	120.00	170.00	200.00	250.00	11.50	12.50	20.00	20.00	16.00
Kansas City	62.50	75.00	140.50	155.00	......	......	13.50	18.00	.55‡	.45‡	2.61§
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	11.50	.....	18.70	.....	19.70
Minneapolis	77.00	84.00	143.00	165.00	173.00	240.00	11.00	18.00	25.50	21.00	21.00
Montreal	.....	110.00	......	......	260.00	......	19.00	32.00	23.00	13.00	16.00
New Orleans	58.40	62.30	116.90	159.20	194.60	......	13.00	.....	23.00	12.50	1.95§
New York	81.00	86.00	129.00	193.30†	238.80†	295.60†	12.75	.....	19.00	15.00	20.00
Philadelphia	77.40	82.50	154.70	185.70	238.80	295.60	15.00	18.00	16.30	11.15	10.65
Pittsburgh	44.00	48.00	95.00	106.00	118.00	143.00	15.00	20.00	16.25	15.25	17.20
St. Louis	65.00	70.00	125.00	145.00	165.00	215.00	15.00	18.00	.60‡	.45‡	2.40§
San Francisco	68.00	76.50	174.00	......	......	......	14.00	16.00	22.50	19.00	15.50
Seattle	80.00	87.00	200.00	......	......	......	14.00	16.00	30.00	25.00	3.00§

*6x12x12 in. †F.o.b. Perth Amboy, N. J. ‡Per sack. §Per bbl.

ROAD SURFACING MATERIALS

	PAVING BRICK AND BLOCKS			PAVING ASPHALT Per ton, less than 80 penetration, f.o.b. city		ASPHALT BINDERS—FLUXES Per gal., 80-300 penetration, f.o.b. city		CUTBACK ASPHALT Per ton, f.o.b. city		ROAD OILS Per gal., f.o.b. city	ASPHALT EMULSION Per gal., f.o.b. city	
	Granite per M, lots of 50,000, 4x4x8 in., f.o.b. city	Brick per M, 3x8½x4 in., carload lots f.o.b. city	Wood per sq.yd., 3½ in., 16-lb. treat, f.o.b. city	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$3.00*	$35.00	$2.25	$18.20	$23.41	$0.0726	$0.0989	$20.45	$27.22	$0.0728	$0.105	$0.105
Baltimore	140.00	44.00	2.25	17.00	22.00	.07	.095	.08†	.115†	.....	.....	.....
Birmingham	65.00	24.00	....	18.00	23.00	0.778	.1028	.082†	.112†	.....	.06	.....
Boston	100.00	32.00	2.25	18.00	23.00	.075	.10	.085†	.12†	.065	.09	.125
Chicago	145.00	42.00	....	.....	.....	....	.....	.....	.....	.....	.....	.....
Cincinnati	115.00	37.00	....	17.40	21.40	.09	.....	18.00	.....	.07	.08	.11
Cleveland	115.00‡	36.00	2.77	18.50	22.70	.0725	.085	.075†	.0875†	.0475	.09	.1025
Dallas	.....	25.50	....	16.45	21.10	.0584	.0809	19.60	25.00	.0484	.1384	.1684
Detroit	.....	35.50	....	14.29	16.88	.....	.....	13.94	17.94	.....	.....	.....
Kansas City	.....	32.00	2.75	14.00	20.00	.06	.10	.08	.12	.06	.07	.09
Los Angeles	.....	48.50	....	12.00	16.00	12.00#	16.00#	14.00	.....	.042	.0525	.1125
Minneapolis	.....	.....	2.50	20.10	24.10	.098	.098	21.75	34.55	.048	.....	.....
Montreal	.....	100.00	....	14.00	19.66	.07	.093	19.00	26.50	.07	.125	.155
New Orleans	110.00	35.00	....	13.00	18.00	.065	.09	.07†	.10†	.....	.....	.....
New York	130.00§	47.50	2.64	17.00	22.00	.07	.095	.08†	.115†	.065	.085	.12
Philadelphia	120.00	45.00	2.02	15.00	20.00	.06	.....	.07	.10	.06	.....	.....
Pittsburgh	115.00	35.00	....	19.00	24.00	.0775	.1125	.086†	.121†	.0675	.....	.....
St Louis	105.00	35.00	2.00	19.50	24.50	.0775	.1075	.0875†	.1175†	.04	.09	.125
San Francisco	.....	45.00	....	12.00	18.00	12.00#	18.00#	14.00#	21.50#	.04	.08	.12
Seattle	.....	47.50	....	18.00	23.10	18.00	23.10	15.00	.....	.02	19.20#	34.20#

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N. J., per ton, Bermudez, $25.00; Trinidad, $21.00. *Per sq. yd. †Per gallon. ‡4½x6x5½in #Per ton §4x5x9-in. Av.

CURRENT PRICES OF CONSTRUCTION MATERIALS

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE Per 100 lb., carload lots	REINF. BARS Per 100 lb., ¾-in. billet, carload lots	RIVETS Per 100 lb., ½-in. structural carload lots	WIRE NAILS Per 100 lb., base, carload lots	SHEET PILING Per 100 lb., base, carload lots	STEEL RAILS Per Gross Ton Standard	STEEL RAILS Light	STEEL RAILS Re-rolled	TRACK SUPPLIES Per 100 lb., carload lots Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham...	$1.85	$1.95	.....	$2.35	.....	$36.375	$32.00	$31.00	$2.55	$2.40	$1.90	$3.25
Chicago........	1.75	1.95	$2.85	2.35	$2.10	36.375	32.00	31.00	2.55	2.40	1.90	3.55
Pittsburgh.....	1.70	1.90	2.75	2.35	2.00	36.375	32.00	31.00	2.55	2.40	1.90	3.55

IRON AND STEEL PRODUCTS—LOCAL PRICES F.O.B. WAREHOUSE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price New billet	Rail steel	EXPANDED METAL LATH —Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING —Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq.yd.	SHEET PILING Per 100 lb. base price
Atlanta..............	$3.34	$2.17	$2.02	$19.50	$22.50	$1.60	$1.21	$0.151	$2.45
Baltimore............	2.85	2.70	2.50	18.50	24.00	1.46	1.12	.137	2.60
Boston...............	3.42	2.73	2.35	20.25	24.25	1.50	1.14	.142	2.40
Chicago..............	3.60	2.43	....	20.50	24.00	1.46	1.12	.137	2.00
Cincinnati...........	3.30	3.10	3.10	20.50	23.50	1.44	1.11	.135	....
Cleveland............	3.06	2.95	2.22	18.50	22.00	1.44	1.11	.135	....
Dallas...............	3.85	3.60	3.50	27.75	32.50	1.70	1.27	.161	....
Denver...............	3.29	3.57	....	23.00	27.00	1.70	1.27	.161	....
Detroit..............	3.30	2.635	2.635	18.50	21.50	1.48	1.13	.139	2.165
Kansas City..........	3.75	2.82	2.63	19.00	.....	1.54	1.17	.145	2.60
Los Angeles..........	2.95	2.80	....	25.00	30.00	1.90	1.40	.18	2.50
Minneapolis..........	3.35†	2.67†	2.52†	20.50†	24.00†	1.58	1.20	.149	2.40†
Montreal.............	3.25	3.00	2.80	.....	.....	....	....	....	3.30
New Orleans..........	3.50	3.00	....	19.50	23.00	1.58	1.20	.149	....
New York.............	3.27	2.52	2.37	20.50	24.00	1.54	1.17	.139	....
Philadelphia.........	1.905	2.19	2.04	18.50	22.00	1.44	1.11	.135	2.28
Pittsburgh...........	1.70‡	1.75‡	1.65‡	17.00‡	22.00‡	1.44	1.11	.135	2.00‡
St. Louis............	3.34	2.815	2.665	24.80	28.00	1.46	1.12	.137	....
San Francisco........	3.25	3.15	2.95	21.50	24.50	1.90	1.40	.18	2.40
Seattle..............	3.40	3.50	....	.....	.....	1.90	1.40	.18	....

†F.O.B. City. ‡Base Mill Price. Note: Shapes, bars and piling subject to quantity discounts.

PAINTS AND ROOFING SUPPLIES

	WHITE LEAD Per 100 lb. keg in oil, f.o.b.	READY-MIXED PAINT Per gal., drums, f.o.b. Graphite*	Aluminum†	Ferric Oxide‡	ROOFING SUPPLIES Carload lots, f.o.b. city Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating, per gal.	Tar pitch, 350-lb. bbl., per ton
Atlanta..............	$11.50	$1.60	$1.10	.....	$1.94	$3.02	$3.30	$0.37	$22.80
Baltimore............	11.00	1.25	2.25	$2.00	1.70	1.60	1.80	.28	24.00
Birmingham...........	.....	2.25	2.25	1.75	2.50	2.50	2.85	.55	23.00
Boston...............	11.50	1.50	2.40	.04x	1.875	2.625	2.625	.485	23.00
Chicago..............	11.00	1.85	2.25	1.25	1.60	1.50k	1.50k	.29	20.00
Cincinnati...........	11.00	1.40	3.00	1.55	2.40	2.25k	2.25k	.36	25.00
Cleveland............	11.00	1.65	2.35	.....	1.60	50.00°	50.00°	.39	19.50
Dallas...............	12.00	1.90	2.10	1.50	2.17	1.98k	2.08k	.37	33.00
Denver...............	11.75	.....	2.55	.....	2.75	3.46	3.46	.60	30.00
Detroit..............	11.00	1.55	2.35	1.30	1.60	2.35	2.50	.40	20.00
Kansas City..........	11.12½	1.50	2.10	1.35	1.75	1.85	2.15	.30	26.50
Los Angeles..........	10.75	1.60	2.25	2.30	2.00	1.50	.....	.45	.....
Minneapolis..........	11.13	.....	.....	.....	1.60	1.50k	1.50k	.2925	23.30
Montreal.............	9.75	1.70	3.45	1.65	.....	2.62	2.02	1.40§	1.63§
New York.............	11.00	1.70	2.35	1.48	1.60	1.50k	1.50k	.29	20.00
Philadelphia.........	9.90	1.50	2.10	1.50	1.60	1.50	1.50k	.29½	20.00
Pittsburgh...........	11.00	1.05	1.95	.80	1.90	1.65k	1.65	.31	23.00
St. Louis............	11.00	1.85	2.25	1.25	2.20	1.50k	1.50k	.46	20.00
San Francisco........	10.75	.....	.....	.....	.....	.....	.....	.45	.....
Seattle..............	10.75	.....	1.92	.....	3.10	4.50	.....	.54	27.60

*New Jersey State Hwy. Spec. 120M. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. °Per ton. §Per 100 lb. kPer roll, 65 lb. xPer lb.
Note: Red lead dry, same as white lead in oil, red lead in oil 50c higher.

MISCELLANEOUS ITEMS

	WINDOW GLASS Discounts from latest jobbers list, Sept. 15, 1928 Single or Double Thickness A quality	B quality	EXPLOSIVES Per lb. dynamite delivered 50-lb. cases Gelatin 40%	60%
Atlanta..........	85%	85%	$0.215	$0.2375
Baltimore........	88%	90%	.18	.195
Birmingham.......	89%	90%	.125	.140
Boston...........	88%	90%	.2225	.2375
Chicago..........	87%	89%	.17	.195
Cincinnati.......	......	......	.22	.245
Cleveland........	85%	85%	.1825	.1925
Dallas...........	......	......	.30	.35
Denver...........	84@ 5%	86@ 5%	.19	.205
Detroit..........	87@10%	89@10%	.237	.255
Kansas City......	89@10%	89@10%	.16	.18
Los Angeles......	90%*	90@40%*	.1725†	.1925†
Minneapolis......	84%	86%	.1725	.1875
Montreal.........	......	......	.1875	.2125
New Orleans......	87@10%	96@10%	.19	.22
New York.........	87%	89%	.23	.245
Philadelphia.....	88@10%	90@10%	.215	.24
Pittsburgh.......	86%	88%	.1175	.1325
St. Louis........	87%	89%	.1375	.1525
San Francisco....	90%	90@30%	.1575	.1725
Seattle..........	90@10%	90@20%	.1525	.1675

*Disc. from list Aug. 1, 1929. †F.o.b. Arsenal.

CHEMICALS

Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.90
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	19.50
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, 60 deg., in drums, f.o.b. works, per 100 lb.	1.65
Soda ash, 58%, in bags, per 100 lb.	1.25
Sulphate of aluminum, in 100 lb. bags per ton	27.50
Sulphate of copper, in bbl., per 100 lb.	3.75

PILES

Prices of Nichols Bros., 90 West St., N. Y. C., per linear foot, pine, with bark on, .b., New York; delivered from barge, 1½ to 2c, per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$0.90	$1.20
	Pine, untreated	.90	1.20
	Pine, creosoted	1.35	1.85
New York	Long-leaf sap pine, untreated	.80	1.00
	Mixed oak, untreated	....	1.00
Birmingham	White oak, untreated	.75	1.50
	White oak, creosoted	1.40	1.45
	Southern pine, untreated *6x8x8′6″	1.00*	1.20
	Southern pine, creosoted	1.20*	1.40
Chicago	White oak, untreated	1.15	1.45
	Oak, empty cell, creosoted	1.50	1.85
	Oak, zinc treated	1.40	1.70
	Southern pine, creosoted	1.35	1.58
Los Angeles	Fir, untreated	.64	.89
	Fir, creosoted	1.84	2.59
Philadelphia	Red oak, untreated	1.00	1.50
	Red oak, creosoted	1.20	1.85
St. Louis	White oak, untreated	1.10	1.55
	Red oak, untreated	1.00	1.45
	Red oak, creosoted	1.40	1.95
	Sap Pine or cypress, untreated	.90	1.25
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

CURRENT PRICES OF CONSTRUCTION MATERIALS

WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton, f.o.b. 6 in. and over b. & s. class B and heavier, C/L lots*	VITRIFIED SEWER PIPE Per foot, delivered, standard				CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b.		CONC. SEWER PIPE Per ft., delivered; ASTM Spec. C 14-24		WROUGHT STEEL PIPE Full std. weight. Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ½ in., 9c; ¾ in., 12c.; 1 in., 17½c.; 2 in., 37½c.; 2½ in., 59c.; 3 in., 77c.; 4 in., $1.10; 6 in., $1.94. 1 to 3 in., Butt Weld		2½ to 6 in., Lap Wel	
		8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	6 in.	8 in.	12 in.	24 in.	Black	Galv.	Black	Galv.
Atlanta	$40.00	$0.225	$0.405	$1.4625	$3.25	$80.00	$128.00	$0.625	$1.625	52%	44.5%	50%	42%
Baltimore	43.50	.33	.58	2.60	5.00	95.00	175.00	.75	2.00	....	....	....	....
Birmingham	36.00	.25	.45	1.625	.....	85.00	......	....	....	49.55%	36.23%	54.86%	43.95%
Boston	45.50	.294	.567	1.89	5.8425	68.25	101.00	.432	1.935	55.59%	44.83%	56.85%	46.10%
Chicago	44.00	.35	.675	2.25	5.125	120.00	200.00	.675	2.25	....	....	....	....
Cincinnati	43.00	.224	.432	1.71	5.2275	90.00	......	.38	1.30	57.33%	46.31%	58.55%	47.53%
Cleveland	44.50	.217	.4185	1.845	5.945	42.50	88.50	.536	2.102	59.4%	48.4%	60.6%	49.6%
Dallas	48.00	.3325	.465	.....	.....	176.00	297.00	.60	2.27	....	....	....	....
Denver	56.00	.25‡	.415‡	1.73‡	.....	100.50‡	......	.....	.....	....	....	....	....
Detroit	44.50	.28	.54	2.25	5.125	100.00	150.00	.....	.....	....	....	....	....
Kansas City	46.00	.33	.52	1.90	3.85	120.00	180.00	.....	.....	....	....	....	....
Los Angeles	44.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.00	....	....	....	....
Minneapolis	46.50	.24‡	.432‡	1.728‡	4.35‡	65.00	120.00	.....	.....	$7.80–35.12	$9.67–43.55	$32.08–74.98	$38.21–90.70
Montreal	.....	.....	1.02	3.64	.....	.....	......	.....	.....	....	....	....	....
New Orleans	42.00	.28	.392	1.90	.....	45.00	......	.45	1.65	....	....	....	....
New York	43.00	.35	.675	2.83	7.48	.....	......	.55	2.00	56.164%	45.144%	57.389%†	46.368%†
Philadelphia	41.50	.28	.54	1.80	.....	135.00	210.00	.....	.....	56.65%	45.63%	57.88%	46.86%
Pittsburgh	46.00	.175‡	.3375‡	1.53‡	4.8175‡	46.00	82.00	.75	1.75	67.5%	58.5%	68.5%†	59.5%†
St. Louis	37.00	.27	.486	1.944	3.96	85.00	195.00	.90	2.28	55.796%	44.76%	57.021%	46.0%
San Francisco	44.00	.25	.45	1.80	4.50	112.00	170.00	.....	.....	60.1%	52.4%	62.4%	53.1%
Seattle	45.50	.35	.63	2.52	.....	84.00	200.00	.50	1.60	60.3%	51.3%	63.3%	52.3%
Burlington, N.J. (base)	40.00	.....	.....	.....	.....	.....	......	.....	.....	.....	.....	.....	.....

*Gas pipe and class A, $3 per ton additional, 4-in., $3 per ton additional. †3½ to 6 in. ‡f.o.b.

LUMBER AND TIMBER

		SHORT LEAF YELLOW PINE AND DOUGLAS FIR Per M ft. b.m., carload lots f.o.b. All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft.									LONG LEAF Y. P. Per M ft. b.m., C/L lots, f.o.b., merchantable grade up to 20 ft.	
		1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10 S4S	3x12 Rgh	6x12 Rgh.	12x12, Rgh.	2x12, Rgh.	12x12, Rgh.
Atlanta	Southern Pine	$20.00	$21.00	$23.00	$20.00	$21.50	$22.00	$30.00	.....	.....	40.00	$45.00
Baltimore	Southern Pine	26.00	27.00	31.50	29.50	30.00	33.00	39.00	.....	.....	55.00	58.00
	Douglas Fir	28.50	29.50	32.00	31.00	32.00	33.00	33.50	$32.50	$32.50	.....	.....
Birmingham	Long Leaf	30.00	30.00	33.00	33.00	33.00	35.00	60.00	.....	.....	42.00	60.00
	Southern Pine	23.00	23.75	25.75	22.00	24.50	25.50	28.00	.....	.....	.....	.....
Boston	Southern Pine	32.00	33.00	40.00†	40.00†	60.00‡	65.00‡	70.00‡	.....	.....	70.00	70.00
	Douglas Fir	31.00	31.00	40.00	40.00	42.00	43.00	42.00	42.00	42.00	.....	.....
Chicago	Southern Pine	34.00	35.00	33.00	32.	33.00	34.00	49.00	65.00	65.00	54.00	54.00
	Douglas Fir	40.00	42.00	40.00	40.00	40.00	42.00	50.00	50.00	50.00	.....	.....
Cincinnati	Southern Pine	32.00	32.00	32.00	31.00	31.00	34.00	40.00	.....	.....	.....	.....
	Douglas Fir	.....	.....	.....	.....	.....	.....	47.50	47.50	50.00	.....	.....
Cleveland	Southern Pine	30.50	31.50	33.50	30.00	32.25	33.00	45.00	44.25ₗ	.....	.....	47.00§
Dallas	Southern Pine	30.00	31.00	32.50	28.60	31.25	32.75	42.50	.....	.....	45.25	40.70
	Douglas Fir	.....	.....	35.00	33.25	33.25	33.50	41.50	46.00	46.00	.....	.....
Denver	Douglas Fir	.....	38.00*ᵐ	43.50*	43.00*	43.00*	44.50*	44.50*	49.00*	.....	.....	.....
Detroit	Southern Pine	29.00	30.00	32.00	29.00	31.00	32.00	36.00	.....	.....	34.00	47.00
	Douglas Fir	.....	.....	.....	.....	.....	.....	44.00	45.00	47.00	.....	.....
Los Angeles	Douglas Fir	27.00	27.00	27.00	27.00	27.00	30.00	27.00	31.00	28.00	.....	.....
Minneapolis	Western Pine	49.50*	47.00*	43.50*	41.00*	41.00*	41.00*	53.25*ᵏ	.....	.....	.....	.....
	Douglas Fir	46.50*	47.00*	42.75*	38.00*	38.00*	40.00*	49.75*	50.20*	53.25*	49.50*ᵏ	.....
Montreal	Spruce	25.00	26.50	22.00	24.00	25.50	32.50	34.50	.....	.....	40.25	.....
	Douglas Fir	47.50	47.50	42.75	51.25	51.25	57.75	.....	.....	.....	.....	.....
New Orleans	Southern Pine	25.60	27.20	28.80	24.80	28.00	28.00	38.40	.....	.....	33.60	54.40
	Douglas Fir	28.00	30.00	31.00	28.00	31.00	31.00	31.00	.....	.....	.....	.....
New York	Southern Pine	35.25*	36.50	38.00*Av.	37.00*Av.	38.00*Av.	40.00*Av.	47.75	.....	.....	$67¾–75½	77.25*
	Douglas Fir	44.75*	43.00*	43.50*	44.00*	41.75*	45.00*	45.00	40.00*	40.00*	.....	.....
Philadelphia	Southern Pine	27.50	28.50	30.50	27.25	29.00	30.25	35.00	.....	.....	66.00	64.00
	Douglas Fir	.....	.....	35.50	35.50	35.00	35.00	35.00	35.00	35.00	.....	.....
Pittsburgh	Southern Pine	26.50	27.75	32.75	29.25	31.75	32.75	41.50	.....	.....	57.50	57.50
	Douglas Fir	33.50	34.50	34.50	33.50	34.00	34.25	46.25	46.25	46.25	.....	.....
St. Louis	Southern Pine	38.00*	39.00*	41.00*	37.50*	40.00*	41.50*	50.00*	.....	.....	61.50*	72.50*
	Douglas Fir	.....	.....	.....	.....	.....	.....	57.00*	57.00*	57.00*	.....	.....
San Francisco	Douglas Fir	28.00	28.00	28.00	28.00	28.00	30.00	29.00	31.00	31.00	.....	.....
Seattle	Douglas Fir	22.50	21.50	21.50	21.00	22.00	22.50	20.00	20.00	22.00	.....	.....

*Delivered. †Spruce. ‡Long-leafed Y. P. §Norway Pine. ᵏNorthern Pine. ₗ Douglas fir. ᵐNative. Av. Average.

CURRENT BUILDING AND CONSTRUCTION WAGE RATES PER HOUR

	Bricklayers	Carpenters	Structural Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const
Atlanta	$0.75/1.125	$0.40/.90	$0.60/1.25	$0.60/1.25	$0.50/.75	$0.30/.40	$0.30/.40
Baltimore	1.10	1.10	1.10	1.10	1.10	.45	.45
Birmingham	1.00	1.00	1.00	1.125	1.00	.30	.30
Boston	.90/1.30	.70/1.17½	1.20	.90/1.17½	.90/1.62½	.40/.70	.40/.70
Cincinnati	1.27½	1.02½	1.20	1.07½	1.27½	.45	.40
Chicago	1.50	1.31½	1.35	1.31½	1.50	.82½	.82½
Cleveland	1.25	1.12½	1.25	1.125	1.25	.72	.72
Dallas	1.12½	1.00	1.00	1.00	1.25	.40	.40
Denver	.60/1.12½	.60/.87½	.60/.87½	.60/.87½	......	.50	.50
Detroit	1.00/1.10	.75/1.25	1.00	.70/90	1.25	.50	.50
Kansas City	1.32½	1.12½	1.12½	1.12½	1.32½	.60/.70	.62½
Los Angeles	.90	.75	1.12½	.75	1.00	.50	.60
Minneapolis	.90/1.00	.75	.90	.75	.90	.40	.50
New Orleans	1.00	.75	1.00	1.00	1.25	30./.40	.30/.40
New York	1.65	1.40	1.65	1.65	1.50	.82½	.82½
Philadelphia	.75/1.20	.60/1.20	1.00/1.20	.75/1.00	.60/1.20	.30/50	.30/.50
Pittsburgh	.50/1.00	.50/1.00	.50/1.00	.50/1.00	.50/1.00	.35/.50	.35/.50
St. Louis	1.50	1.25	1.47	1.35/1.47	1.50	.78¾	.35/.78¾
San Francisco	1.12½	.90	1.20	1.00	1.10	.60	.60
Seattle	1.20	.90	1.10	1.00	1.20	.60	.60
Montreal	1.20	.55	.85	.85	.85	.30	.20

Skilled Ave: (Bricklayers, Carp., Ironworkers) $1.0687. Common Ave. $0.5268